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Besserdich et al.

[11] **3,859,898**

[45] **Jan. 14, 1975**

[54] **METHOD OF AND APPARATUS FOR STACKING FLEXIBLE ARTICLES**

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[73] Assignee: **FMC Corporation,** San Jose, Calif.

[22] Filed: **July 26, 1973**

[21] Appl. No.: **382,807**

Related U.S. Application Data

[62] Division of Ser. No. 198,385, Nov. 12, 1971, Pat. No. 3,766,701.

[52] **U.S. Cl.** ..... **93/93 M,** 93/93 R, 93/93 DP, 270/45, 270/58, 270/69, 270/85

[51] **Int. Cl.** **B31b 1/94**

[58] **Field of Search** ..... 93/93 M, 93 HT, 93 DP, 93/93 R; 198/30, 31, 32; 214/6 A, 6 F

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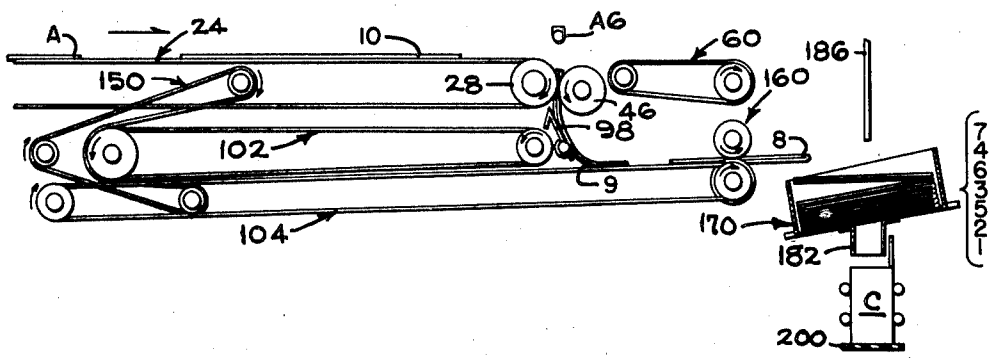
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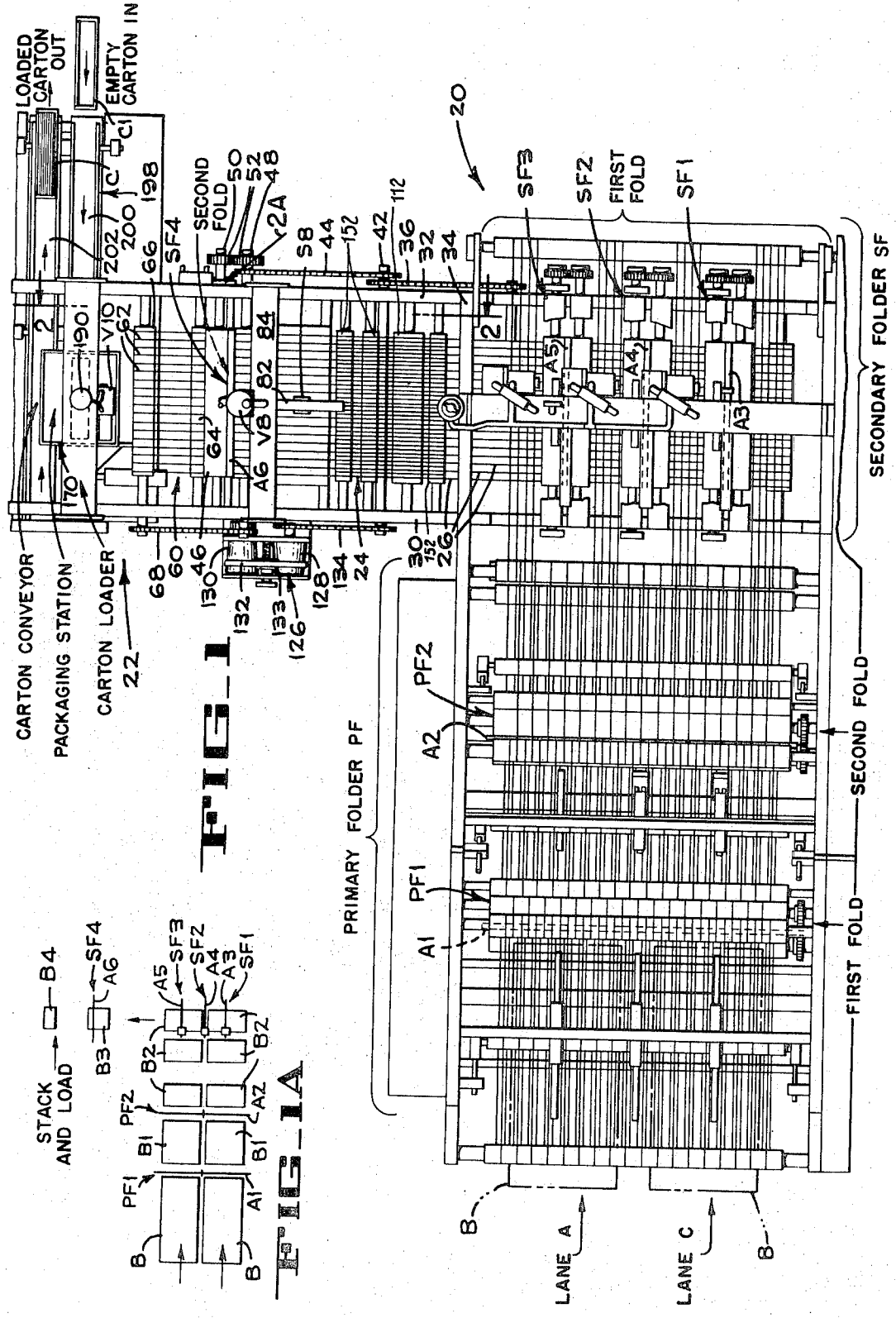
Primary Examiner—Roy Lake
Assistant Examiner—James F. Coan
Attorney, Agent, or Firm—C. E. Tripp

[57] **ABSTRACT**

A packing method, and apparatus for effecting the method, wherein a stack of flexible articles such as film bags are positioned over a support having a narrow aperture extending from one edge of the stack to the opposed edge so that the central portion of the stack is unsupported. An open top carton is positioned beneath the aperture, and an overhead plunger with line contact on the top of the stack pushes downward in alignment with the aperture to buckle the stack of bags and force them through the aperture into the carton. While one stack of bags is being packed, some of the first bags of the next stack are diverted from the conveying path, and are followed by subsequent bags. This diverting operation thus allows time for the packaging operation without interruption of the continuous output of the machine supplying the bags.

10 Claims, 21 Drawing Figures




LOADED CARTON OUT
EMPTY CARTON IN
C1
C
198
200
202
SECOND FOLD
50
52
48
2A
SF4
66
58
44
152
42
112
36
32
34
20
SF3
SF2
FIRST FOLD
SF1
SECONDARY FOLDER SF
190
V10
62
84
82
64
V8
A6
A5
A4
A3
70
68
60
46
130
132
133
126
128
134
24
30
152
26
CARTON CONVEYOR
PACKAGING STATION
CARTON LOADER
22
PRIMARY FOLDER PF
PF2
A2
PF1
A1
SECOND FOLD
FIRST FOLD
B
LANE A
LANE C
B
FIG. 1
STACK AND LOAD
B4
SF4
A6
B3
A5
SF3
SF2
A4
A3
SF1
B2
B2
PF2
B1
A2
B1
PF1
A1
B
B
FIG. 1A

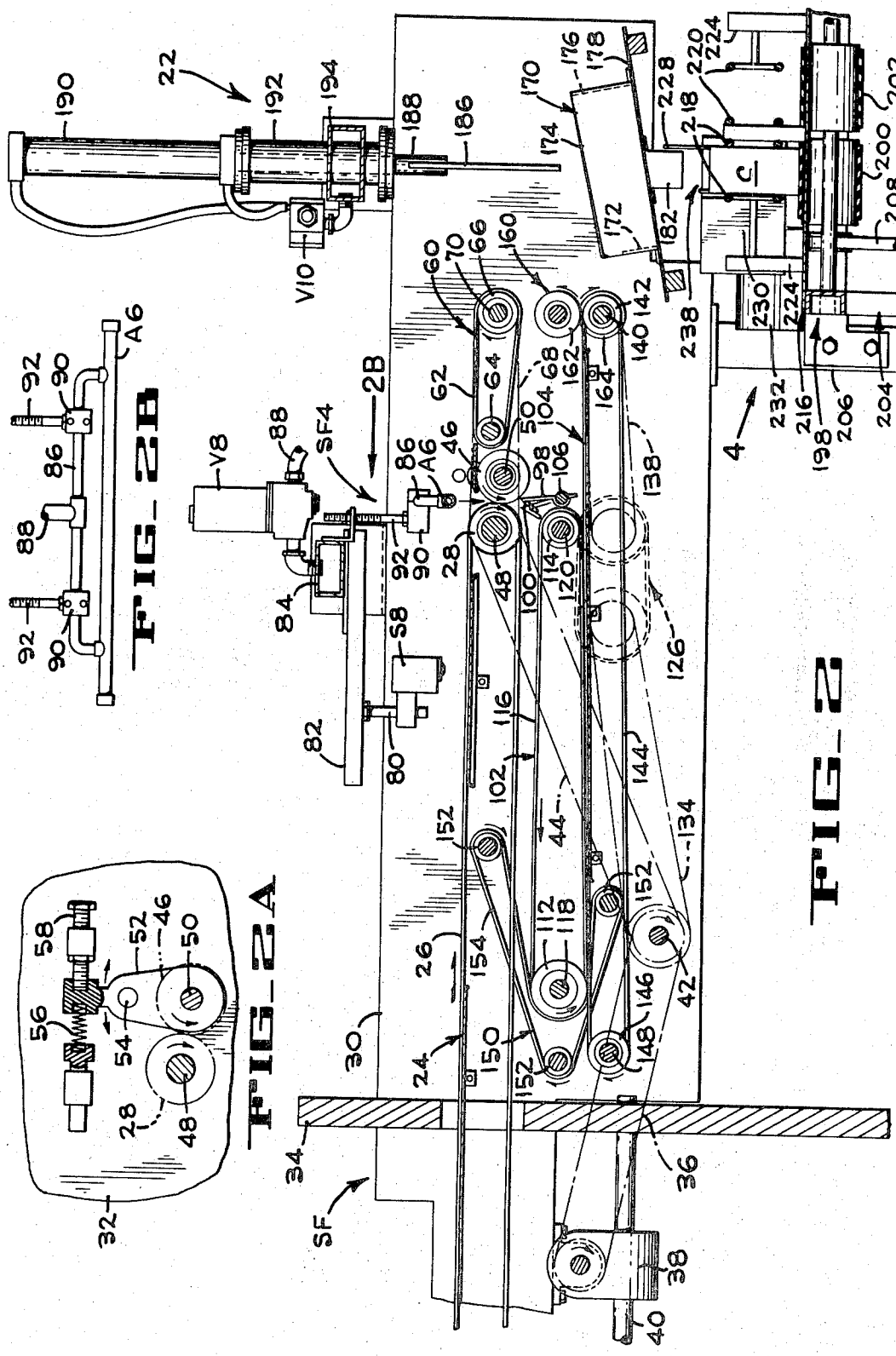


FIG_2

FIG_2A

FIG_2B

FIG_3

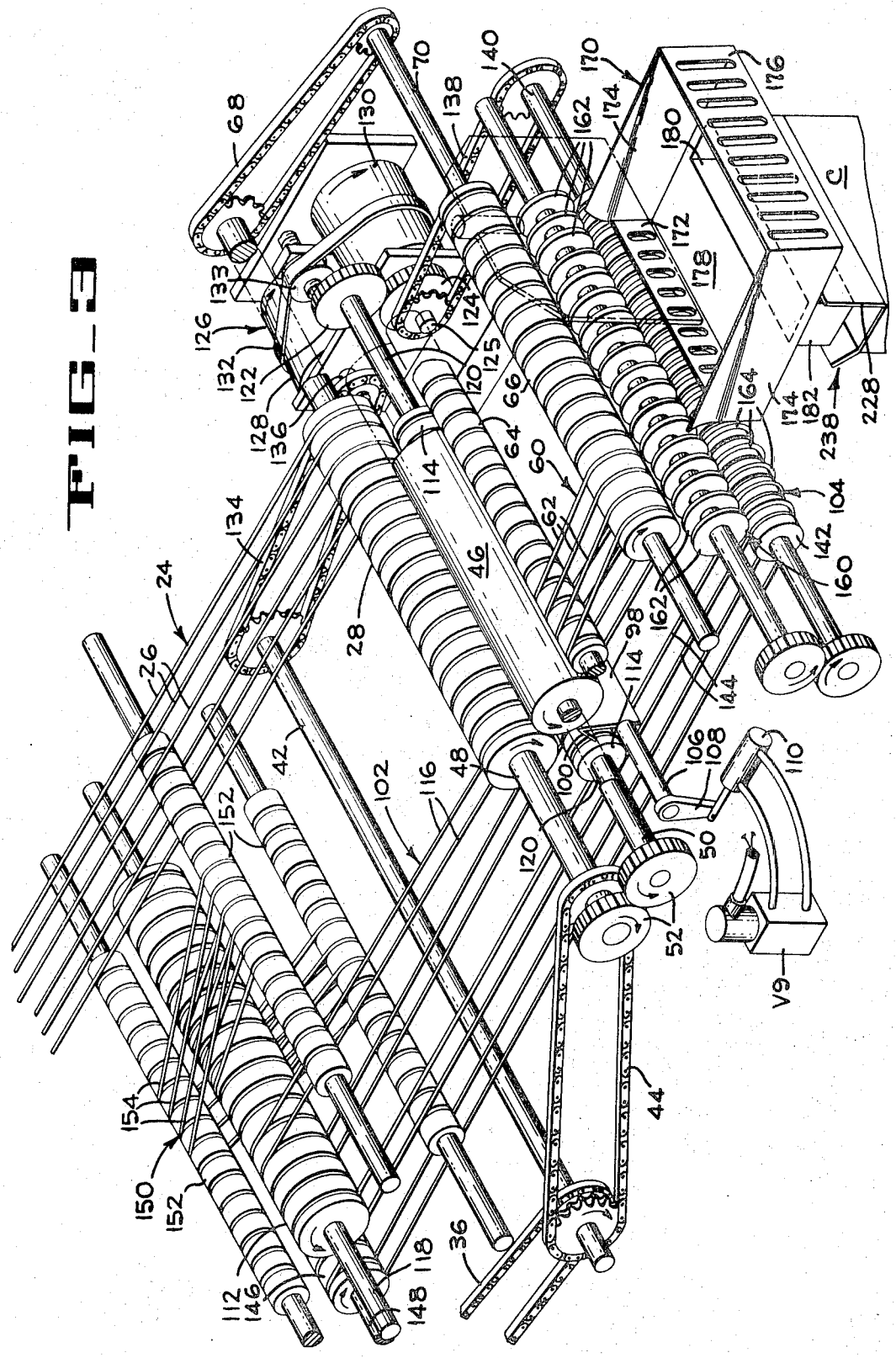

68
70
130
138
140
162
170
174
176
180
C
172
178
133
126
124
125
120
132
122
128
136
66
64
60
62
114
46
134
24
26
28
42
102
116
48
100
152
120
98
144
104
142
160
106
108
110
50
52
V9
154
150
152
112
146
148
118
36
44
164
174
182
238
228

FIG_4

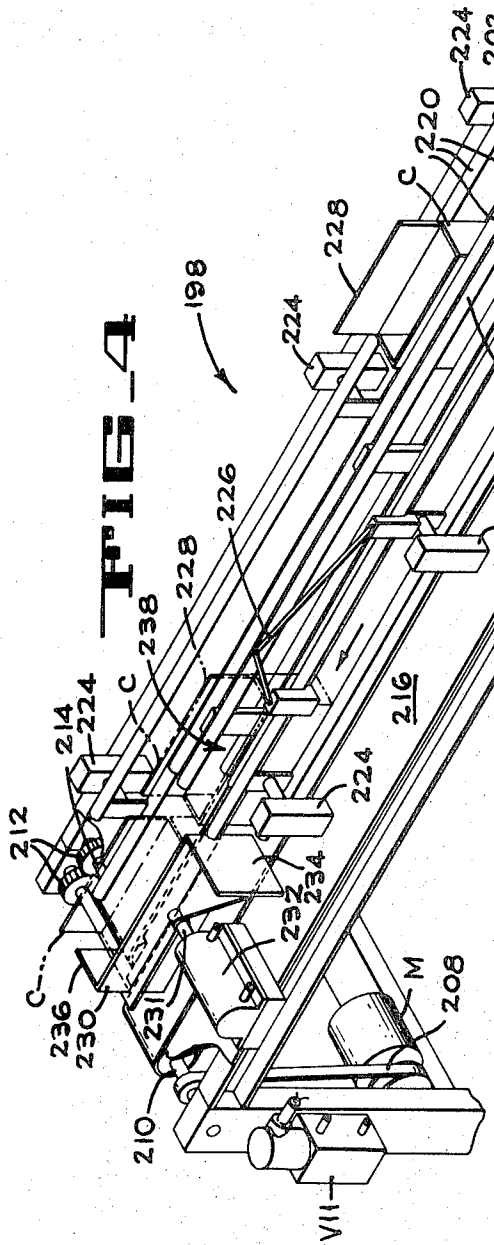

198
224
202
220
C
228
224
200
224
204
218
226
224
228
238
C
214
224
216
224
212
232
234
231
C
236
230
M
208
210
VII

FIG_5

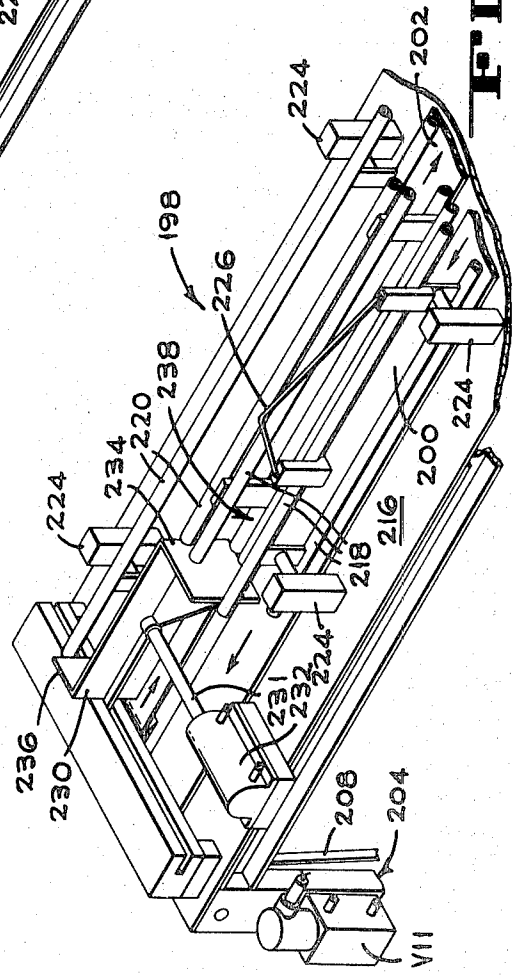

224
202
198
226
238
220
234
224
200
224
216
218
224
231
232
236
230
208
204
VII

FIG_6

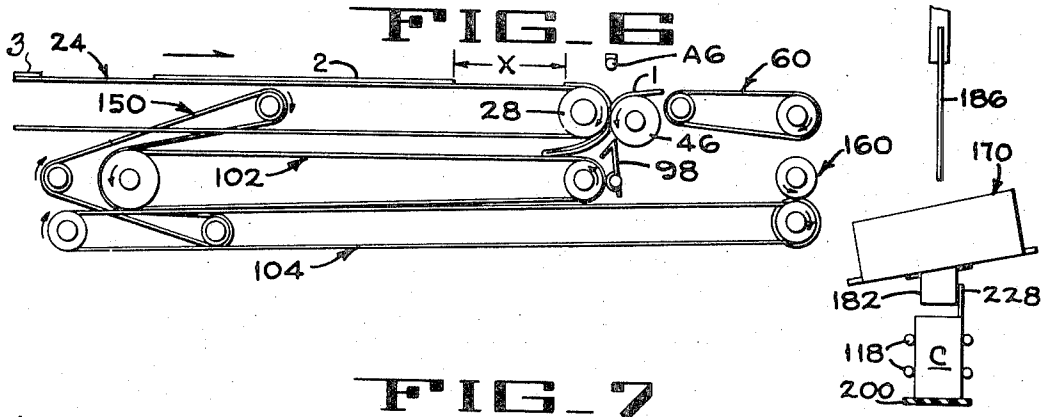


FIG_7

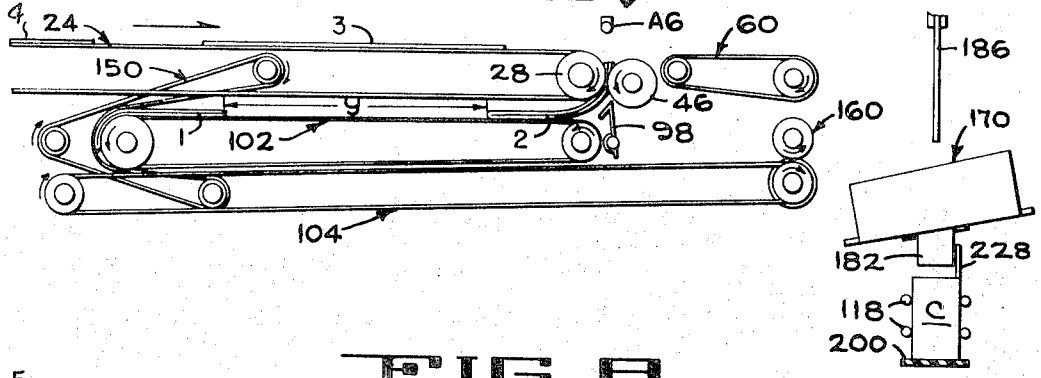
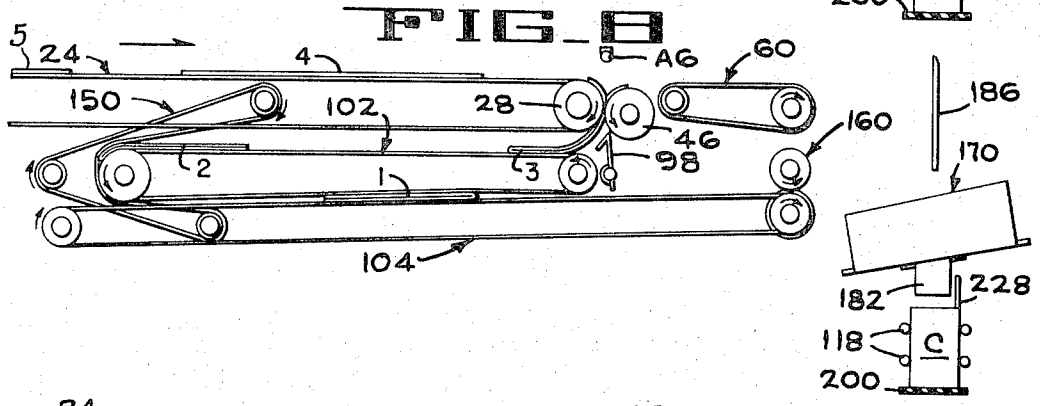


FIG_8



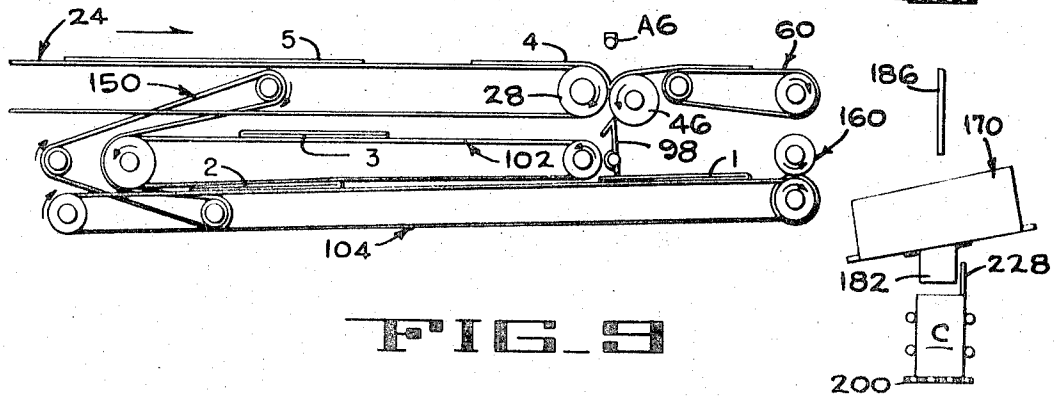


FIG_9

FIG_10

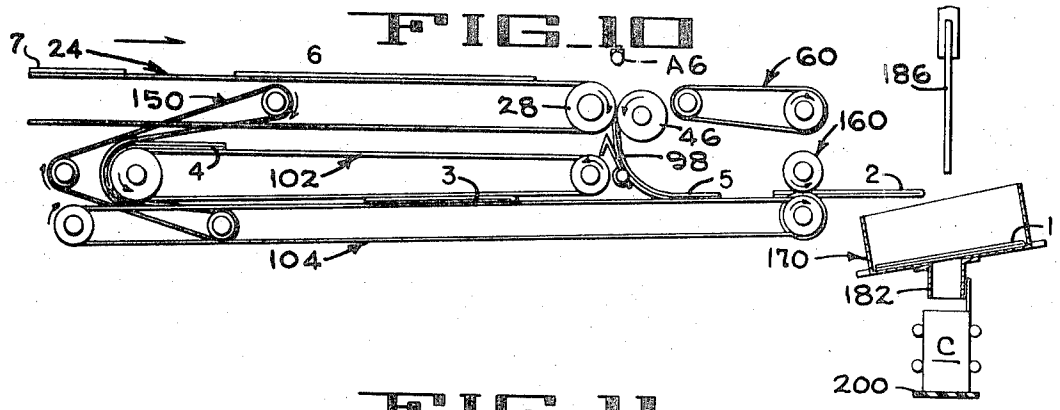


FIG_11

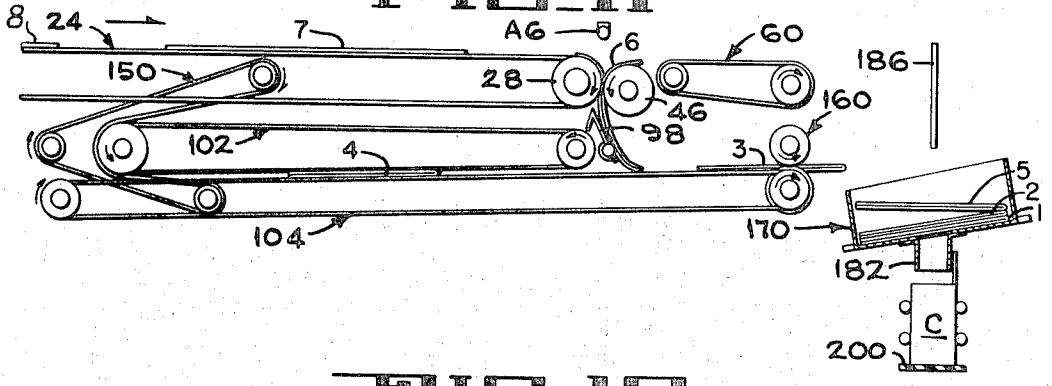
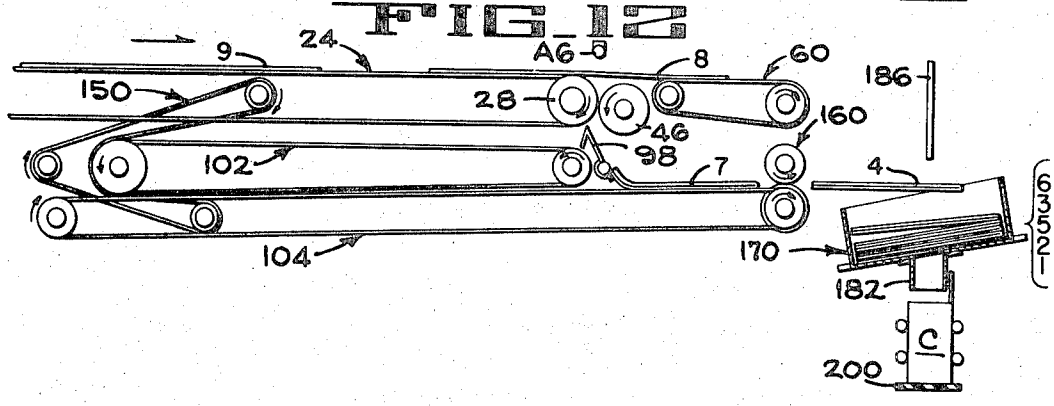


FIG_12



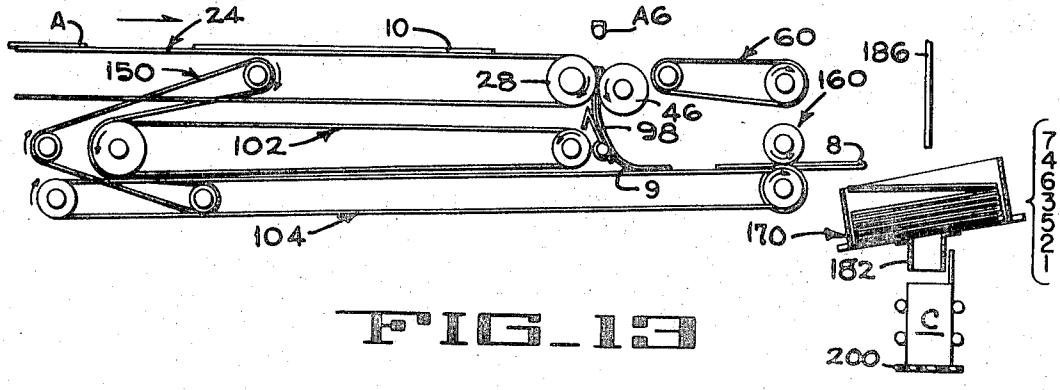


FIG_13

FIG_14

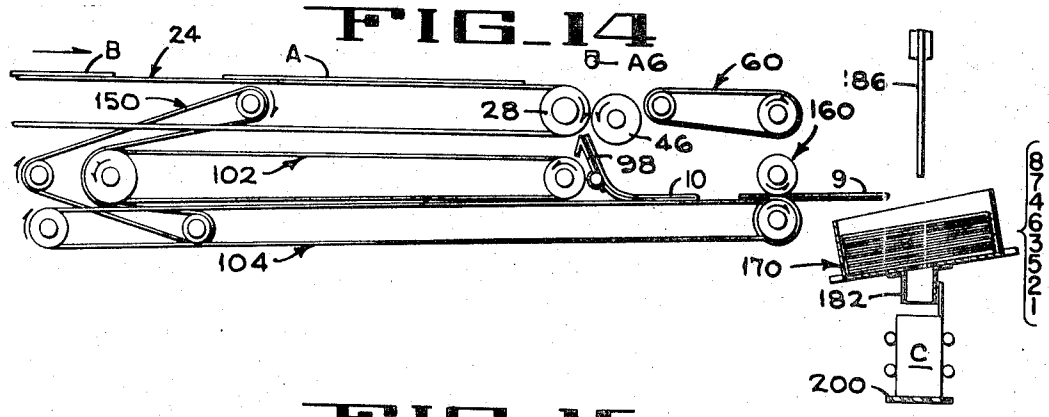


FIG_15

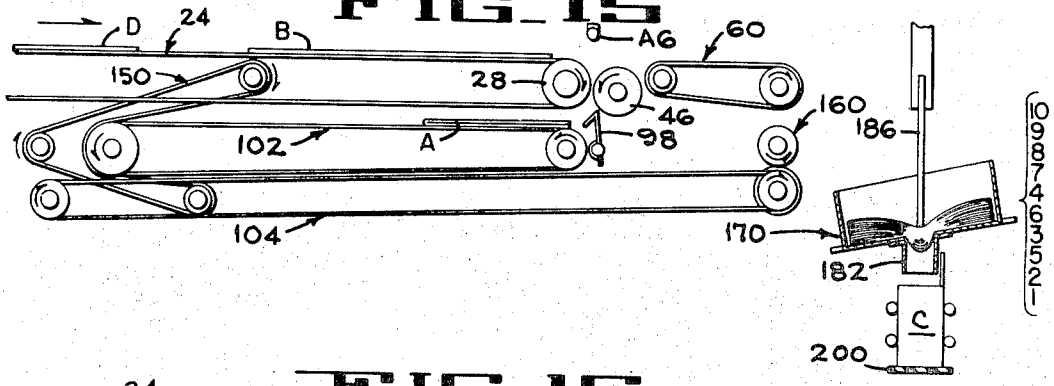
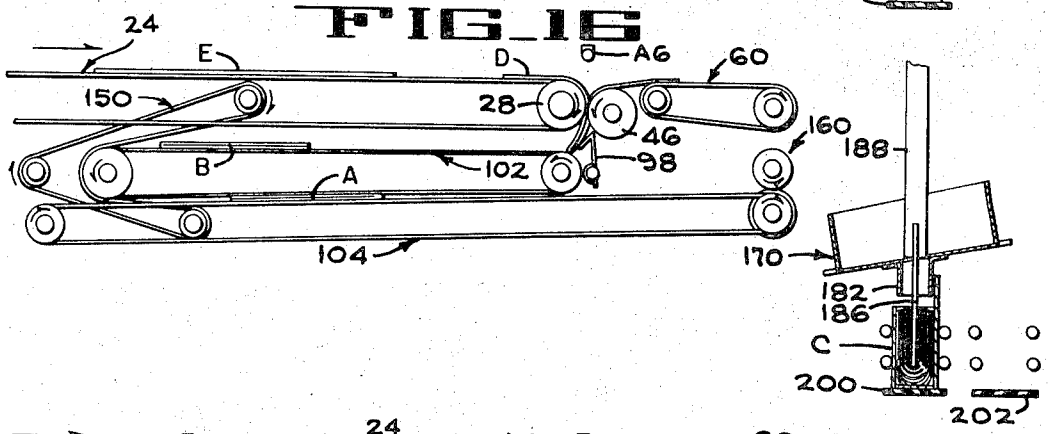


FIG_16



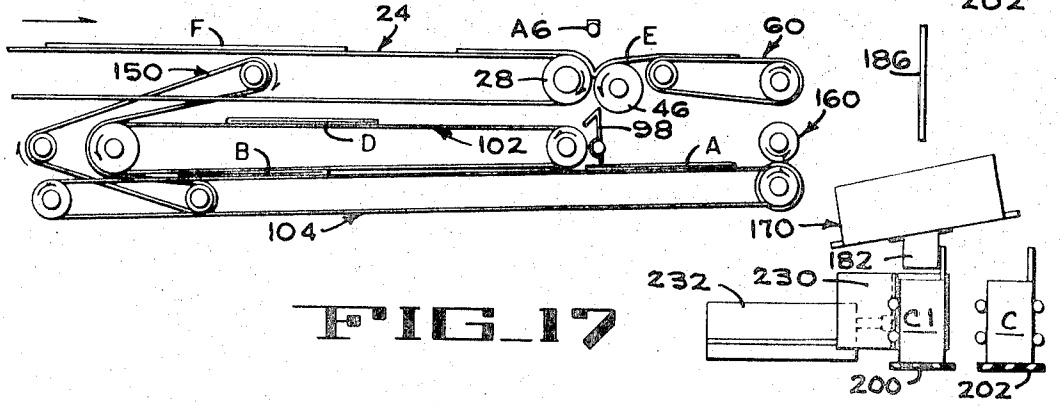


FIG_17

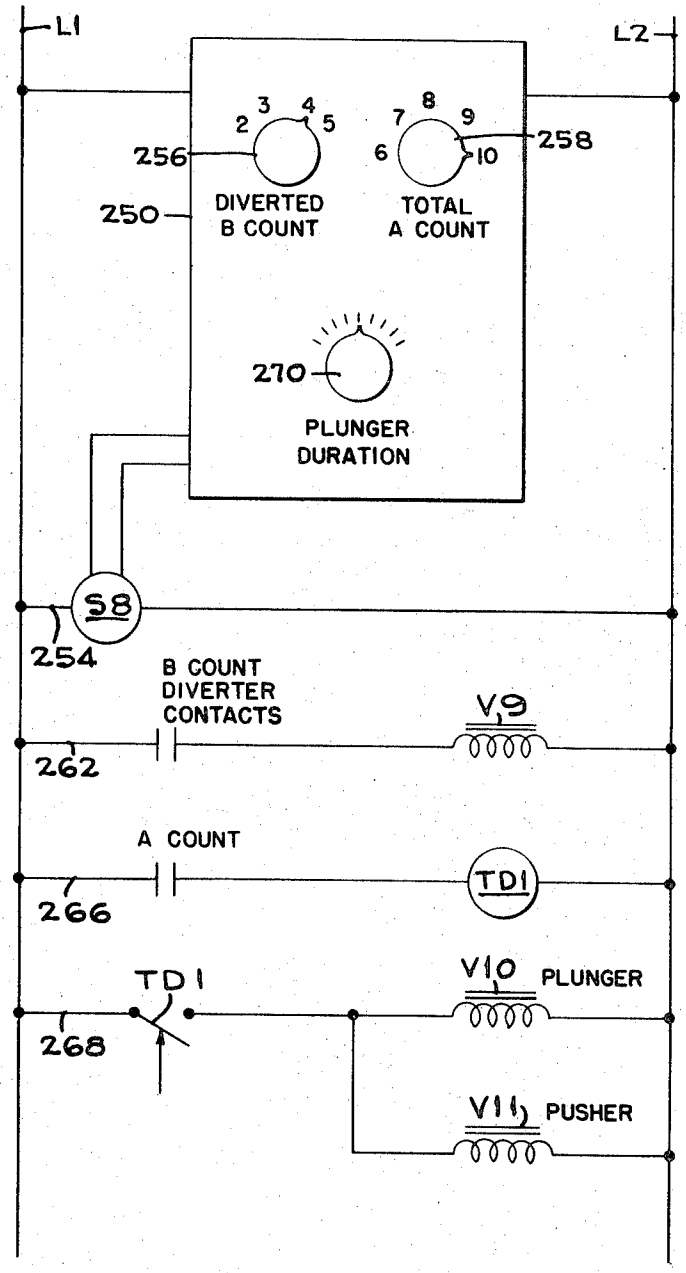

L1
L2
2
3
4
5
6
7
8
9
10
256
258
250
DIVERTED
B COUNT
TOTAL
A COUNT
270
PLUNGER
DURATION
S8
254
B COUNT
DIVERTER
CONTACTS
V9
262
A COUNT
TD1
266
TD1
V10
PLUNGER
268
V11
PUSHER

FIG_18

METHOD OF AND APPARATUS FOR STACKING FLEXIBLE ARTICLES

This is a division of application Ser. No. 198,385, filed Nov. 12, 1971. This application issued on Oct. 23, 1973 as U.S. Pat. No. 3,766,701.

BACKGROUND OF THE INVENTION

The field of the present invention is packaging apparatus for placing a stack of flexible, flat articles such as film bags into a carton. More specifically, the present invention has special utility with a bag folding machine which produces folded film bags and has a continuous, uninterrupted production cycle. A bag machine of this type is disclosed in our pending patent application Ser. No. 141,127, which issued as U.S. Pat. No. 3,790,157 to Crawford et al. on Feb. 5, 1974, which is assigned to the assignee of the present invention and which is incorporated herein by reference.

The above identified bag folding machine is associated with a high production rate bag making machine, and provides a continuous output of folded and closely interspaced bags at rates as high as 200 per minute. For obvious reasons of efficiency, it is undesirable to interrupt the bag making and folding cycle to package the output of folded bags. At the same time, it will be appreciated that the problem of handling an output of one bag about every 3/10 of a second is substantial.

Bags of the type referred to are packaged in relatively small numbers, sometimes as few as six per carton. At a production rate of 200 bags per minute and a packing charge of six bags per carton, more than 33 packages per minute must be loaded and moved in a continous cycle. The present invention provides a packaging method and apparatus for continuous operation within these parameters.

SUMMARY OF THE INVENTION

By diverting part of the output of folded bags in each carton charge without interrupting the continuous production cycle, and then recombining the diverted with the non-diverted bags, sufficient time is gained for a rapid loading operation with the bags of another carton charge during the diverting operation. A simplified loading operation is provided wherein one loading stroke simultaneously places an entire carton charge in a carton.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic plan of a known type of bag folding machine incorporating the packaging apparatus of the present invention.

FIG. 1A is a diagrammatic plan showing one mode of bag folding for the FIG. 1 folding machine.

FIG. 2 is an enlarged schematic section taken on lines 2—2 on FIG. 1.

FIG. 2A is a schematic elevation of an adjustable roll mounting bracket assembly indicated by the arrow 2A of FIG. 1.

FIG. 2B is an enlarged schematic elevation indicated by the arrow 2B on FIG. 2.

FIG. 3 is an enlarged schematic perspective of the major operating components shown in FIG. 2.

FIG. 4 is an enlarged schematic perspective of carton handling structure indicated by the arrow 4 on FIG. 2.

FIG. 5 is a fragment of the FIG. 4 structure showing a different operational position.

FIGS. 6–17 are diagrammatic operational views showing the sequential bag handling functions performed by the FIG. 2 apparatus.

FIG. 18 is a schematic control diagram.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 discloses the bag folding machine 20 of our previously identified patent application, the detailed construction of which is not critical to the present disclosure, and the packaging apparatus 22 of the present invention operating in cooperation with the bag folding machine 20.

The bag folding machine 20 may be operatively associated with various types of known bag making machines that heat seal and sever a film web, either to produce the side-weld type of bag or the bottom seal type of bag and to discharge the bags in one, two or three output lanes. In the present disclosure, the bag construction is immaterial, but the illustrated bag folding machine is assumed to receive a dual lane input of bags B illustrated at the left ends of FIGS. 1 and 1A in input LANE A and input LANE C. The bag folding machine 20 is capable of carrying out various folding operations, as disclosed in the above identified patent application, but in the present case is assumed to fold each bag B four times, in the manner next explained.

The bag folding machine 20 (FIG. 1) comprises a primary folder PF and a secondary folder SF, each including various rollers and narrow conveying belts for transporting the bags past folding stations PF1 and PF2 of the primary folder PF, and then at right angles relative to their former direction of movement past folding stations SF1, SF2, SF3 and SF4 of the secondary folder SF. At the folding station PF1 (FIG. 1A) jets of air from an air tube A1 force the transverse central portion of the bags downward through nip rolls indicated generally at PF1 (FIG. 1). This causes the bags to be transversely folded in half, as indicated by the folded bags B1 in FIG. 1A. The bags B1 then pass under a second air tube A2 at the folding station PF2 and the central transverse portion of the once folded bags are forced downward through nip rolls indicated generaly at PF2 (FIG. 1) and a second transverse fold is effected so that the bags B2 (FIG. 1A) are one-fourth their former length measured along the conveying path.

The bags B2 processed to the secondary folder SF and briefly stop under air tubes A3 and A5 where jets of air force the bags downward into nip rolls at the folding stations SF1 and SF3, and fold each bag in half along a transverse line perpendicular to the previous folds. Conveyed now in a single lane toward the folding station SF4 and under an air tube A6, the bags B3 are once more folded in half, the resulting four-times folded bags B4 being ready for stacking and packaging. The present invention concerns the packaging apparatus 22, and the packaging method carried out by the packaging apparatus.

Some indication of the scope of the problems inherent in packaging the bags B4 may be realized from the continuous production rate at which the bag folding machine operates. With the two input, single lane output mode above outlined, each lane of the primary folder PF can produce an input to the secondary folder SF of 100 bags per minute. Since the two input lanes are combined for a single lane output, the production rate for the bags B4 is 200 per minute. Further, the type

of bags here considered are large, heavy gauge trash can liners which may be packaged as few as six per carton. It is evident, therefore, that unless the continuous production cycle is interrupted, loaded cartons must be produced at the rate of 33 ⅓ cartons per minute, or more than one carton every two seconds. A further consideration is that both the bag making machine and the bag folding machine operate best when run continuously, not to mention the undesirable significant drop in production rate if the cycle is interrupted. The packaging apparatus **22** allows the uninterrupted production of folded bags from the bag folding machine **20** at 200 bags per minute, and automatically packages this output in cartons containing as few as six bags per carton.

Before proceeding with a detailed structural description of the packaging apparatus **22,** it should be noted that the last folding operation at the folding station SF4 is in the present embodiment conveniently combined with the packaging apparatus. In applications to other folding machines, the folding station SF4 may be considered a part of the packaging apparatus. However, the packaging method and the carton loading structure, alone, have broader applications, and are useful in many other environments where stacks of thin, flexible articles are to be packaged, for example, paper napkins, separator sheets for patty making machines, and so forth.

With reference now to FIGS. **1** and **2,** the folded bags are discharged from the secondary folder SF of the bag folding machine **20** on the upper flight of a belt-type main conveyor **24** which comprises a plurality of round-section elastic belts **26** trained around a grooved idler roller, not shown, in the bag folding machine, and around a grooved driven nip roll **28.** The nip roll **28** is mounted between side plates **30** and **32** that are centilevered from the primary folder PF.

If the packaging apparatus **22** is used as a separate machine instead of a built in unit, the side plates **30** and **32** can extend up to the discharge end of the machine with which it cooperates, such as the plate **34** in FIG. **2** which in the present instance is the side plate of the primary folder PF. The idler roller for the belt conveyor **24** is then mounted between the side plates **30** and **32.** In either case, the drive train for the packaging apparatus **22** can be taken from the parent machine, as indicated by the chain and sprocket drive train **36** which originates at a right-angle gear box **38** of the secondary folder SF. The gear box is driven by a shaft **40,** and operates in timed relation with the bag folding operations carried out in the secondary folder.

A jackshaft **42** extends through the side plates **30** and **32** and is driven by the drive train **36** to power a chain and sprocket drive train connection **44** to the nip roll **28** to deliver the folded bags to the folding station SF4. Cooperating with the nip roll **28** is a nip roll **46.** The mounting shafts **48** and **50** (FIG. **1**) of the nip rolls extend through the side plate **32** and carry intermeshing gears **52** so that the nip rolls counterrotate. Both nip rolls are jacketed with resilient sleeves to provide optimum frictional contact with the film bags, and are manufactured to close tolerances to provide a uniform nip pressure. It is preferable to mount each end of the downstream nip roll **46** in the manner shown in FIG. **2A.** The shaft **50** extends through clearance apertures in the side plates **30** and **32** and is held at each end portion in a pivot bracket **52** pivoted at **54** to one of the frame plates **30** or **32.** A compression spring **56** biases the upper end of the pivot bracket against an axially adjustable stop bolt **58,** the adjusted position of which regulates the clearance between the fixed nip roll **28** and the movable nip roll **46** so that the nip clearance can be preset. A further advantage is that the resilient mounting will accommodate material variations in bag thickness, such as may be caused by entrapped air.

The air tube A6 (FIGS. **2** and **2B**) is mounted directly over the nip of the nip rolls **28** and **46** to direct downward jets of air across the central portion of a bag supported by the main conveyor **24** and an overrun conveyor **60** which supports that portion of the bag which overruns the nip rolls, and which is formed of round elastic belts **62** trained around grooved resilient rolls **64** and **66.** As best shown in FIG. **3,** the roll **66** is driven by a chain and sprocket drive **68** to the nip roll mounting shaft **48,** and to a shaft **70** which carries the roll **66.**

For initiating the air blast in the air tube A6 (FIGS. **2** and **2B**) which forces the bag to buckle downward into the nip rolls, a retro-reflective sensor **S8** is mounted upstream of the nip rolls above the upper flight of the main conveyor **24** to sense the trailing edge of a bag approaching a longitudinally centered position over the nip rolls. The sensor **S8** is clamped to a post **80** that is adjustable in the direction of bag movement on a rail **82.** Rail **82** is secured to the underside of an air manifold **84** which supplies pressure regulated air for the air tube, as controlled by a solenoid operated valve V8 which is actuated under control of the sensor **S8.**

As shown in FIG. **2B,** the air tube **A6** has closed ends and includes a tubular yoke **86** for distributing air to the end portions of the air tube, and a central flexible hose **88** which is connected to the valve **V8.** A clamp block **90** grips each end portion of the yoke and is secured to a vertically adjustable bolt **92** so that the air tube is both vertically adjustable and can be swung about the axis of the yoke **86** to direct the air blast from the most effective location relative to the nip rolls.

When the air tube A6 (FIGS. **2** and **3**) forces a bag into the nip rolls **28** and **46,** as later described in detail, the bag can follow an automatically selected one of two paths, according to the operational position of a pivotable, power actuated diverting gate **98.** The gate **98** is substantially coextensive with the nip rolls and is formed of a planar panel having an angularly disposed return lip **100.** If the gate is in the solid line position shown in FIG. **2,** the lip **100** directs the leading edge of a bag descending from the nip rolls rearward onto the upper flight of a diverting conveyor **102.**

If the diverting gate is in the phantom outline position, the bag will be directed forward onto the upper flight of a discharge conveyor **104.** As best shown in FIG. **3,** the diverting gate **98** is mounted on a pivot rod **106** that is coupled by a link **108** to a double-acting air cylinder **110.** A solenoid operated valve V9 controls the air supply to the air cylinder **110.**

With reference to FIGS. **2** and **3,** the diverting conveyor **102** includes a grooved idler roll **112,** a driven roll **114** and a plurality of elastic round section belts **116.** The rolls are respectively mounted on idler and drive shafts **118** and **120.** A gear **122** on the drive shaft **120** is meshed with the output gear **124** on the output shaft **125** of a variable speed cone pulley transmission **126** so that the linear velocity of the diverting conveyor belts **116** can be adjusted. For this purpose, the trans-

mission **126** includes oppositely oriented input and output cone pulleys **128** and **130,** interconnected by a drive belt **132** that is trained over a pulley **133** which can be set in a selected position across the faces of the pulleys to reposition the belt. Primary drive for the transmission is by means of a chain and sprocket connection **134** between the jackshaft **42** and an input shaft **136** for the cone pulley **128.**

The transmission output shaft **125** also carries a chain and sprocket drive connection **138** to a driveshaft **140** for a grooved drive roll **142** of the discharge conveyor **104.** Elastic belts **144** are trained around the drive roll **142** and an idler roll **146** on an idler shaft **148.** It will be noted that the described drive trains cause the upper flight of the diverting conveyor **102** to travel rearward and the upper flight of the discharge conveyor **104** to travel forward in synchronism. The respective drive ratios to the conveyors from the variable speed transmission **126** provide the same linear velocity for the belts of each conveyor.

It will be recalled that the diverting gate **98,** in the position shown, directs selected bags rearward on the upper flight of the diverting conveyor **102.** At the idler roll **112,** the diverted bags are gripped against the roll by a gripping conveyor **150** so as to follow around the roller **122** and be deposited on the discharge conveyor **104.** Thus, the gripping conveyor **150** includes three grooved idler rolls **152,** and a plurality of elastic belts **154** which are tensioned over non-grooved portions of the idler roll **12.** Frictional contact of the belts **154** with the idler roll **112,** or with a bag therebetween, drives the belts **154.**

As thus far described, it is apparent that all bags folded at the nip rolls **28** and **47** will eventually be ejected over the drive roll **142** of the discharge conveyor **104,** but that some are first diverted rearward onto the opposite end of the discharge conveyor. By thus diverting selected bags, and recombining the diverted bags with the flow of non-diverted bags, the continuous production rate of 200 incoming bags per minute on the main conveyor **24** does not have to be interrupted in order for the packaging apparatus **22** to package that output in groups as few as six bags per carton.

As the bags are ejected from the discharge conveyor **104,** they pass under a corrugating roller assembly **160** which includes discs **152** vertically aligned with each of the belts **144.** Between adjacent belts **144,** a large section **0**-ring **164** is mounted on the drive roll **142.** The O-rings force the bags to assume a wavy or serpentine end profile, so that each bag is temporarily corrugated to lend it beam strength which resists windage as the bag is projected into a stacking tray **170.**

The stacking tray **170** includes a short upright wall **172** at its filling end, and side walls **174** and a rear wall **176** that project upward from an apertured base wall or bag loading plate **178.** The aperture **180** therein extends nearly to each side wall **174** and is centrally located relative to the front wall **172** and the rear wall **176.** Depending from the loading plate **178** and forming an extension of the aperture **180** is a guide chute or discharge throat **182** having vertical walls and adapted to direct a carton-charge of folded bags into a subposed carton C.

According to the method aspect of the present invention the bag stack accumulated in the stacking tray **170** (FIGS. **15** and **16**) is transferred into the carton C by what is most aptly described as "plunge-loading." This includes the rapid application of a downwardly applied force having substantially line contact with the uppermost bag of the stack along a line approximately coincident with a vertical plane bisecting the narrow dimension of the aperture **180.** This force causes the bag stack to buckle upward into U-shape at the sides of the line of force application, simultaneous with a downward movement of the base of the U-shaped stack into and through the discharge throat **182,** and into the subposed carton C. It will be noted that the front and rear walls **172** and **176** of the stacking tray are slotted. The slots release air which would otherwise be largely retained in the stack and interfere with the loading operation.

For carrying out the loading method above outlined, a bladelike plunger **186** is mounted on the piston rod **188** of a double-acting air cylinder **190** for vertical movement through the aperture **180,** the discharge throat **182,** and into the carton C. The air cylinder **190** is mounted on a tube **192** which guides the piston rod and extends through an air manifold **194** that supplies pressure regulated air to the air cylinder **190,** as controlled by a solenoid operated valve V**10.**

For automatically feeding empty cartons C (FIGS. **2** and **4**) to carton loading position, and for discharging the filled cartons to a closing machine or some other type of handling operation, the packaging apparatus **22** includes a carton conveyor **198** having an input conveyor belt **200** and an output conveyor belt **202,** mounted in a fabricated frame **204** which includes support legs **206** (FIG. **2**) for the frame plates **30** and **32.** Both belts are driven by a common motor M, by means including a cog belt drive **208** that powers a driveshaft **210.** To provide opposite directional movement of the belts, the driveshaft **210** is provided with a pair of reversing gears at **212** for driving the driveshaft **214** of the output conveyor belt **202.** The upper flights of both belts slide across a top slide plate **216.** The belts **200** and **202** are respectively straddled by upper and lower pairs of carton guide rods **218** and **220,** supported by posts **224** secured to the slide plate **216.** The uppermost guide rod nearest the secondary folder SF supports a camming rod **226** diagonally across the path of the top closure panel **228** of each carton C to fold the panel into full open position behind the discharge throat **182** (FIG. **2**).

It will be noted that the guide rods **218** and two of the guide rods **220** end short of the other guide rods adjacent the reversing gears **212.** This is to allow a free path for reciprocating movement of an S-shaped pusher plate **230** which provides means to stop an incoming carton C in loading position, means for transferring the carton after loading from the input conveyor belt **200** onto the output conveyor belt **202,** and simultaneously with the transfer step, arrest the next incoming empty carton on the conveyor belt **200** until the pusher plate is retracted to its initial position. Thus, the pusher plate **230** is secured to the piston rod **231** of a double-acting air cylinder **232** controlled by a solenoid actuated air valve V**11.** One side of the pusher plate **230** has a panel **234** which arrests an incoming carton in loading position when the pusher plate is extended as shown in FIG. **5.** The other side of the pusher plate has a panel **236** which arrests the loaded carton in transfer position when the pusher plate is retracted as shown in FIG. **4.** Intermediate the panels **234** and **236,** the pusher plate **230** has coextensive contact with the side of a carton

contacting the panel **234** during transfer of a loaded carton from the input conveyor belt **200** to the output conveyor belt **202.**

In operation, the carton conveyor **198** is supplied with erected empty cartons C placed on the input conveyor belt **200** with the top closure panel **228** in position to be intercepted and folded back about its connecting fold line to the body of the carton by the camming rod **226.** The carton conveyor pusher plate **230** is positioned as shown in FIG. **5,** and the carton is conveyed against the panel **234** and arrested thereby in vertical alignment with the stacking tray discharge throat **182** (FIG. **2**) and ready to receive one stack of bags. After the plunger **186** (FIG. **2**) descends and loads one bag stack from the stacking tray **170** into the carton, (at the loading station indicated in FIGS. **4** and **5** at **238**) the pusher plate **230** is retracted to its FIG. **4** position and the loaded carton moves downstream into contact with the panel **236.** The next forward movement of the pusher plate **230** thus transfers the loaded carton onto the output conveyor belt **202** and arrests an empty carton at the loading station **238.** FIGS. **6–17** illustrate the steps in accumulating one bag stack (FIGS. **6–14**), the carton loading operation (FIGS. **15** and **16**), and the loaded carton ejecting operation as the next stack is accumulated (FIG. **17**).

The operating sequences in FIGS. **6–17** are next described without reference to the details of the control diagram FIG. **18.** It is assumed that an empty carton C has been delivered to the loading position by the input conveyor belt **200,** and that the bag count will be **10** per stack, with no previous loading operations having occurred. The bags forming the first stack are identified by numerals **1–10** in the order at which they arrive at the air tube A**6** for diversion into the nip rolls. The bags destined for the second stack (FIGS. **13–17**) are identified by letters A to E, inclusive.

Bag number **1** (FIG. **6**) was, just prior to the position shown, lying flat on the main conveyor **24** and on the overrun conveyor **60,** and the trailing edge of the bag had previously been sensed by the retro-reflective sensor S**8** (FIG. **2**). The senosr S**8** is arranged to trigger an air blast from the air tube A**6** when the central portion of the bag overlies the nip of the nip rolls, thus pinching the bag and conveying it downward past the gate **98.** Gate **98** is at this time in a position to divert number **1** bag rearward onto the diverting conveyor **102.** Meanwhile, number **2** bag is closely following on the main conveyor **24.**

In FIG. **7,** number **2** bag has been diverted in the same manner as the number **1** bag, with number **3** bag closely following and number **1** bag now passing under the gripping conveyor **150** toward the discharge conveyor **104.**

In FIGS. **8** and **9,** number **3** bag has been diverted onto the diverting conveyor **102,** and number **4** bag will be similarly diverted, because the gate **98** is still in its initial diverting position. After bag **4** arrives on the diverting conveyor **102,** the gate **98** will be switched to its FIG. **10** position. It will be seen that number **1** bag is on the discharge conveyor **104** in FIG. **9,** but is about to be discharged under the corrugating roller assembly **160** into the stacking tray **170.** It is significant to observe that the spacing between bags number **1** and **2** (FIG. **6**) and indicated by the dimension x, increases to dimension y (FIG. **7**) because of the folding operation performed by the nip rolls. This space, and similar spaces between other bags, is later used to combine or interdigitate succeeding bags that are not diverted with the diverted bags **1–4.**

FIG. **10** shows that diverted bag **1** has been projected into the stacking tray **170** from the discharge conveyor **104,** and that bag **2** is about to enter the stacking tray. Meanwhile, the gate **98** has been repositioned so that number **5** bag, instead of being routed onto the diverting conveyor **102,** is being directed onto the discharge conveyor **104** between bags **2** and **3.**

While the above outlined functions are taking place, and indeed, throughout any production run, the bags are continuously moving. At the specified production rate of 200 bags per minute, one bag arrives at the nip rollers every 3/10 of a second. By diverting some of the first incoming bags — here shown as the first four bags — the stacking tray is unobstructed long enough for the plunger **186** to load the carton C and be retracted out of the way for the first bag of the next stack. The loading operation occurs and is explained later, but at this point bags **6–10** remain to be transferred into the stacking tray **170.**

In FIG. **11,** bag **5** is settling in the loading tray above bags **1** and **2,** while bag **6** is being directed onto the discharge conveyor **104** between bags **3** and **4.** Similarly, FIG. **12** shows bag **4** settling in the stacking tray above previously stacked bags **1, 2, 5, 3** and **6.** Bag **7** is being directed into the space behind bag **4,** the last bag which was diverted around the diverting conveyor **102.**

In FIG. **13,** bag **7** is settling on the stack, and is being followed by bags **8** and **9.** Bag **10** also follows the non-diversion path, as shown in FIG. **14,** while bag A of the next stack of bags follows bag **10.** Shortly after the time of the operational position shown in FIG. **14,** bags **9** and **10** have settled on the stack of bags in the stacking tray **170,** so that the final order of bags from bottom to top of the completed stack is **1, 2, 5, 3, 6, 4, 7, 8, 9, 10.**

Bag A, FIG. **15,** of the next stack of bags corresponds to bag number **1** of the stack just assembled, and the gate **98** repositions in time to divert bag A onto the diverting conveyor **102.** Meanwhile, the plunger **186** is descending to buckle the first stack of bags into the discharge throat **182** of the stacking tray **170,** and by the time bag A, FIG. **16,** arrives on the discharge conveyor **104,** the first stack of bags has been fully seated in the carton C.

As shown in FIG. **17,** before the bag A has been ejected from the discharge conveyor **104,** the plunger **186** has retracted to clear the stacking tray **170,** and the powered pusher plate **230** has transferred the loaded carton C onto the output conveyor belt **202.** An empty carton C**1** has been moved to loading position by the input conveyor belt **200,** and the previously described bag diverting, bag recombining and carton loading cycle repeats in the same manner above described.

At this point it should be noted that the diverting of the first four incoming bags is not a limitation of the carton loading apparatus, but is merely illustrative of the manner in which time for the loading operation can be obtained without interrupting the continuous and high speed flow of bags. In some installations, as controlled by the bag production rate, the size of the bags, and other variables such as the length of the diverting conveyor **102,** it may be possible to load a carton with only two or three bags initially diverted, or it may be necessary to divert more than four bags. In any case,

the time available for the carton loading operation is equal to the time required for bag A, FIG. **17**, to reach its illustrated stack entry position via the long conveying path around the diverting conveyor **102**, less the time required for bag **10** of the preceding count to become settled on the stack.

FIG. **18** is a control diagram for automatically effecting the sequence of operations above described, including the functions of controlling the overall count, the number of bags to be diverted, timing of the plunger **186**, and so forth. Since the control system can be effected in different ways with well known and conventional apparatus, once the operating principles are known, FIG. **18** is simplified to merely disclose the general control functions, including:

1. Providing a zero stacking rate for a short period after the first incoming bag is diverted.

2. Doubling the stacking rate when the non-diverted incoming bags are recombined with the diverted bags.

3. Equalizing the stacking rate with the bag input rate after the diverted bags have been stacked.

Electrical power input lines L1 and L2 energizing an adjustable counter **250**, line **252**, which is arranged to start a counting operation when the sensor **S8**, line **254**, sends a control signal or pulse upon sensing the trailing edge of the incoming first bag as mentioned in connection with FIG. **2**. Upon receiving this signal, the counter **250** begins two separate counting operations at each pulse from the sensor **S8**, one which governs the number of bags to be diverted, and another which determines the total count for one stack. Both of these operations are separately adjustable, the diverting operation by a control knob **256**, and the total count by a control knob **258**. Upon delivery of the last of the diverted bags past the gate **98**, FIG. **10**, (bag **4** as indicated by the control knob **256**) diverter contacts **260**, line **262**, are closed by a signal from the counter **250**, and the solenoid operated air valve V9 (see also FIG. **3**) is energized to switch the gate **98** from its former diverting position.

The total count of ten bags, as indicated by the control knob **258** initiates a control pulse to close contacts **264**, line **266**, and energize a time delay relay TD1. After a delay period to allow the last bag to settle on the stack, timed contacts TD1, line **268**, close to energize solenoid operated air valves V10 and V11. The latter valves respectively control the plunger cylinder **190** (FIG. **2**) and the pusher plate **230**, and when energized cause the plunger **186** and the carton pusher **230** to respectively load the stack into a carton, and to transfer a previously loaded carton onto the output conveyor belt **202**. It will be evident that various relays, contacts and other control elements, not shown, are used in an actual control installation to provide repetitive cycling of the described operating sequence, and for the usually required safety interlocks to prevent mechanical damage in the event of malfunction, and to provide interruption of the bag machine **20** in the case of a jam. It is also convenient, for timing purposes, to provide means, such as a control knob **270**, for adjusting the duration of the cycle for the plunger **186** to effect the loading operation.

If the control knob **256** is set to divert the first three incoming interdigitated bags the final order of the bags in the stack **1, 4, 2, 5, 3, 6, 7, 8**, etc. to the total count indicated by the control knob **258**. If two bags are diverted, the stacking order is **3, 1, 4, 2, 5, 6, 7, 8**, and so forth to the total count.

Some of the possible variations of the disclosed packaging apparatus should be noted. If the sensor **S8** (FIG. **2**) is repositioned so that it senses the trailing edge of a bag whose leading edge is at the nip rolls instead of beyond the rolls, the bag will be conveyed downward without any folding operation. Thus, the folding operation is not essential to the invention, nor is it essential that the bags have any folds at all. Similarly, it wiill be apparent that the carton packaging apparatus can be used at the discharge end of the primary folder PF, or as previously indicated, can be used as a separate machine cooperatively associated with other types of machines such as a bag making machine that might discharge directly onto the main conveyor **24**.

Although the best mode contemplated for carrying out the present invention has been herein shown and described, it will be apparent that modification and variation may be made without departing from what is regarded to be the subject matter of the invention.

What is claimed is:

1. A method of accumulating a group of articles from a lane of uniformly interspaced articles moving at a predetermined infeed rate comprising the steps of diverting a number of incoming articles along a curcuitous path, directing the remaining articles at a predetermined first spaced distance apart along an adjacent path, and combining the diverted articles with the remaining articles by placing certain ones of the articles in one path between predetermined ones of the articles in the other path for delivery to an accumulating zone, the resulting order of articles being different than the initial order, and the delivery rate to said accumulating zone being zero during the diverting step and increased relative to said predetermined rate during the combining step.

2. The method of claim **1** including the additional step of directing further articles along said adjacent path after the previous steps so that said article delivery rate equals said predetermined infeed rate after the zero and increased delivery rates.

3. A method according to claim **1** wherein the delivery rate during the combining step is double that of said predetermined infeed rate.

4. A method for accumulating a group of articles from a lane of articles moving at a predetermined infeed rate comprising the steps of folding the articles in half to double the spacing between the articles, diverting a number of incoming articles along a circuitous path at said double spacing, directing the remaining articles at said double spacing along an adjacent path, and combining the remaining articles with the diverted articles by placing certain of the remaining articles in said adjacent path between predetermined ones of said diverted articles for delivery to an accumulating zone, the delivery rate to said accumulating zone being zero during the diverting step and being twice that of said predetermined infeed rate during the combining step.

5. A method according to claim **4** including the additional steps of directing other diverted articles at said double spacing onto said adjacent path prior to said combining step, and directing further articles along said adjacent path after said combining step so that the average article delivery rate equals said predetermined infeed rate.

6. An apparatus for accumulating articles in groups of predetermined numbers from a continuously moving supply of articles comprising, main conveyor means for moving the incoming articles along a first path at a predetermined rate, diverting conveyor means for moving diverted articles received from said main conveyor means along a second path, discharge conveyor means driven in timed relation to said diverting conveyor means for moving articles received from both said main conveyor means and said diverting conveyor means along a third path and for discharging the articles in groups of said predetermined number at a discharge station, diverting means for selectively diverting a predetermined number of articles in each group onto said diverting conveyor means and for directing the remaining articles in each group directly onto said discharge conveying means, and control means for actuating said diverting means for causing a consecutive series of articles in each group of articles to be diverted onto said diverting conveyor means for subsequent conveyance and recombining onto said discharge conveying means at spaced intervals a sufficient distance apart to receive therebetween other articles directly from said main conveyor means.

7. An apparatus according to claim 6 wherein said articles are foldable articles, and additionally comprising means for folding said articles in half as said articles are moving off said main conveyor means and are being diverted by said diverting means for spacing the diverted articles a sufficient distance apart when transferred onto said discharge conveying means to receive therebetween other articles directly from said main conveying means.

8. An apparatus according to claim 6 wherein said consecutive series of articles of each group diverted onto said diverting conveyor means are the foremost articles of each group, thereby minimizing article accumulating time and gaining time for removing each accumulated group of articles from the discharge station.

9. A method of accumulating a group of articles from a lane of uniformly interspaced articles moving at a predetermined infeed rate comprising the steps of diverting a number of incoming articles along a circuitous path, directing the remaining articles along an adjacent path, and combining the diverted articles with the remaining articles by alternately combining certain ones of the articles in one path with predetermined ones of the articles in the other path prior to delivery to an accumulating and stacking zone, the resulting order of articles being different than the initial order, and the delivery rate to said accumulating and stacking zone being zero during the diverting step and being increased relative to said predetermined rate during the combining step.

10. An apparatus for accumulating articles in groups of predetermined numbers from a continuously moving supply of articles comprising, main conveyor means for moving the incoming articles along a first path at a predetermined rate, diverting conveyor means for moving diverted articles received from said main conveyor means along a second path, discharge conveyor means driven in timed relation to said diverting conveyor means for moving articles received from both said main conveyor means and said diverting conveyor means along a third path and for discharging the articles in groups of said predetermined number at a discharge station, diverting means for selectively diverting a predetermined number of articles in each group onto said diverting conveyor means and for directing the remaining articles in each group directly onto said discharge conveying means, control means for actuating said diverting means for causing a consecutive series of articles in each group of articles to be diverted onto said diverting conveyor means for subsequent conveyance and alternate recombining of certain ones of the articles in one path with predetermined ones of the articles in another path onto said driven discharge conveying means, and stacking means for receiving the articles from said discharge conveying means after they have been recombined on said discharge conveying means.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,859,898

DATED : January 14, 1975

INVENTOR(S) : ORRIN H. BESSERDICH et al

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

Column 2,	line 47:	change "processed" to --proceed--;
	line 62:	after "two" insert --lane--.
Column 3,	line 36:	change "cen-" to --can- --.
Column 5,	line 26:	change "122" to --112--;
	line 30:	change "12" to --112--;
	line 34:	change "47" to --46--;
	line 36:	after "some" insert --bags--;
	line 46:	change "152" to --162--.
Column 11,	line 32:	change "said" to --the--.

Signed and Sealed this

second **Day of** *December 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks