United States Patent [19]

Hollis

[11] **3,921,506**

[45] **Nov. 25, 1975**

[54] **APPARATUS FOR THE MANUFACTURE OF DUNNAGE BAG LINERS**

[75] Inventor: **Clinton R. Hollis,** Camden, Ark.

[73] Assignee: **International Paper Company,** New York, N.Y.

[22] Filed: **Mar. 4, 1974**

[21] Appl. No.: **447,763**

[52] **U.S. Cl.** ..... **93/8 VB;** 93/1 WZ; 93/33 H; 93/35 VL

[51] **Int. Cl.²** **B31B 1/84;** B31B 23/00

[58] **Field of Search** .... 93/DIG. 1, 8 VB, 8 R, 33 R, 93/33 H, 35 R, 35 VL, 1 WZ

[56] **References Cited**

UNITED STATES PATENTS

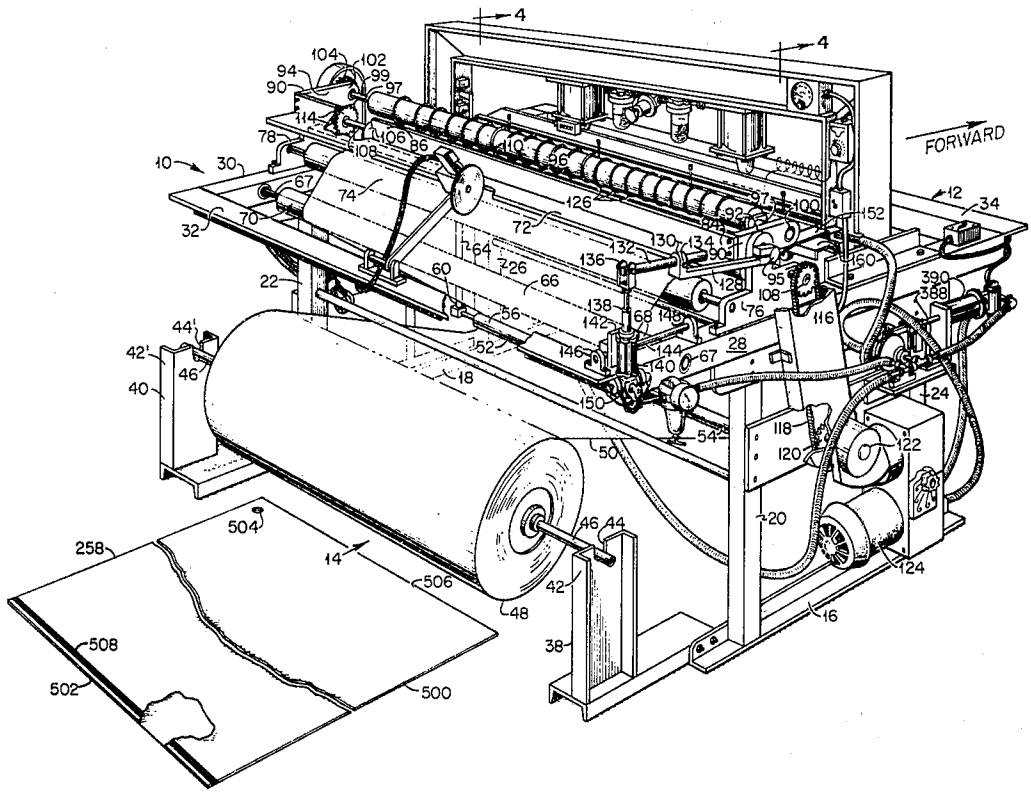
3,069,303	12/1962	Scholle	93/DIG. 1
3,244,576	4/1966	Swartz	93/8 VB X
3,352,737	11/1967	Jordan	93/8 VB X
3,355,996	12/1967	Medleycott et al.	93/33 H X
3,646,856	3/1972	Worndl	93/8 VB X
3,813,998	6/1974	Lotto	93/DIG. 1 X

Primary Examiner—Roy Lake
Assistant Examiner—James F. Coan
Attorney, Agent, or Firm—Fitch, Even, Tabin & Luedeka

[57] **ABSTRACT**

Apparatus for the manufacture of inflatable liners for disposable dunnage bags. The apparatus includes means for measuring and severing an indefinite length of flattened tubular plastic material into predetermined lengths, sealing the overlying layers at one end of each severed length, and cutting an opening in one of the layers suitable for receiving an inflation valve.

9 Claims, 27 Drawing Figures



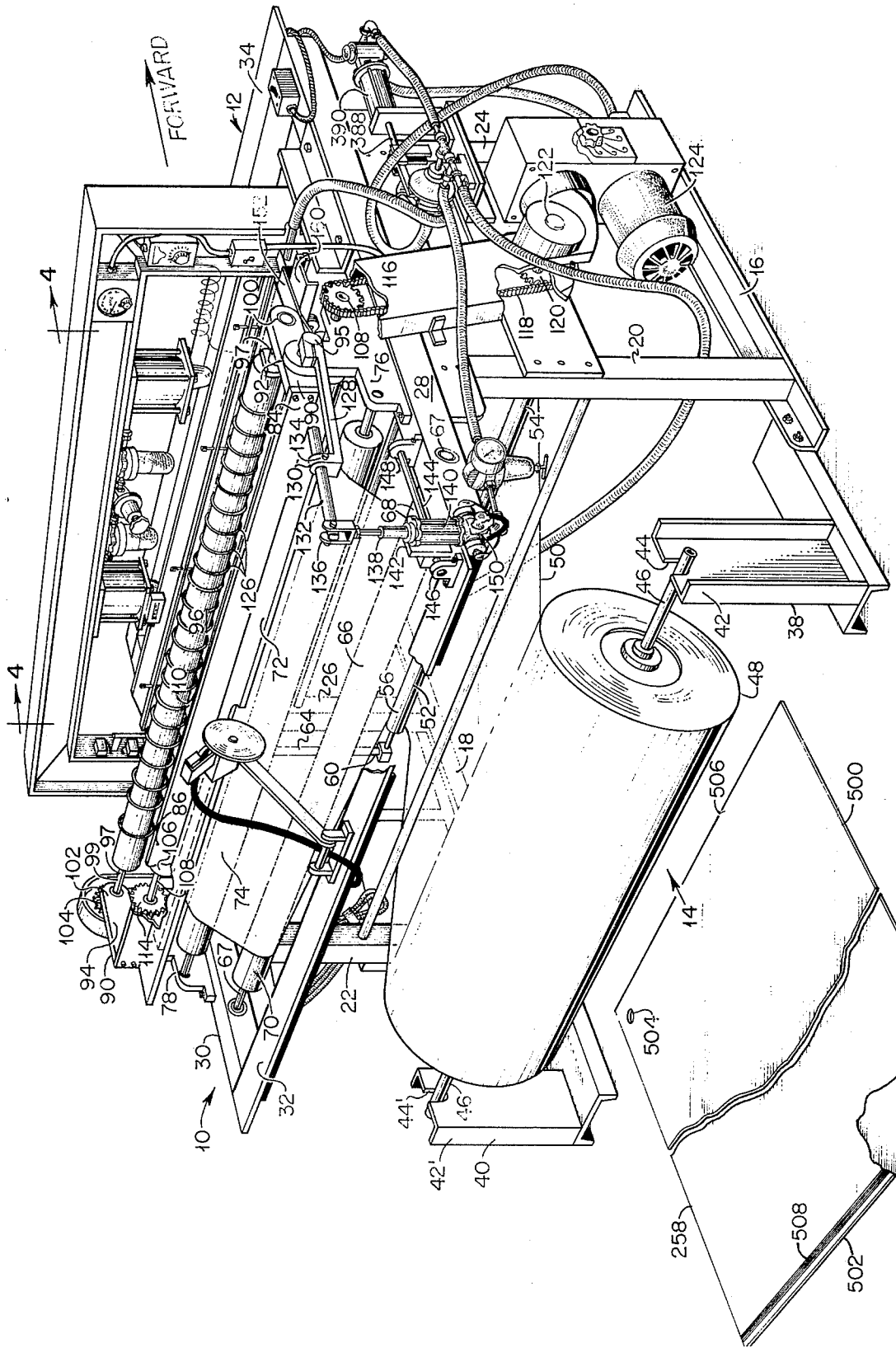

FORWARD
4
4
4
10
12
14
16
18
20
22
24
28
30
32
34
38
40
42
42'
44
44'
46
46'
48
50
52
54
56
60
66
67
68
70
72
74
76
78
80
82
84
86
88
90
92
94
95
96
97
97
99
100
102
104
106
108
110
114
116
118
120
122
124
126
128
130
132
134
136
138
140
142
144
146
148
150
164
226
258
388
390
500
502
504
506
508

Fig. 1.

Fig. 1a

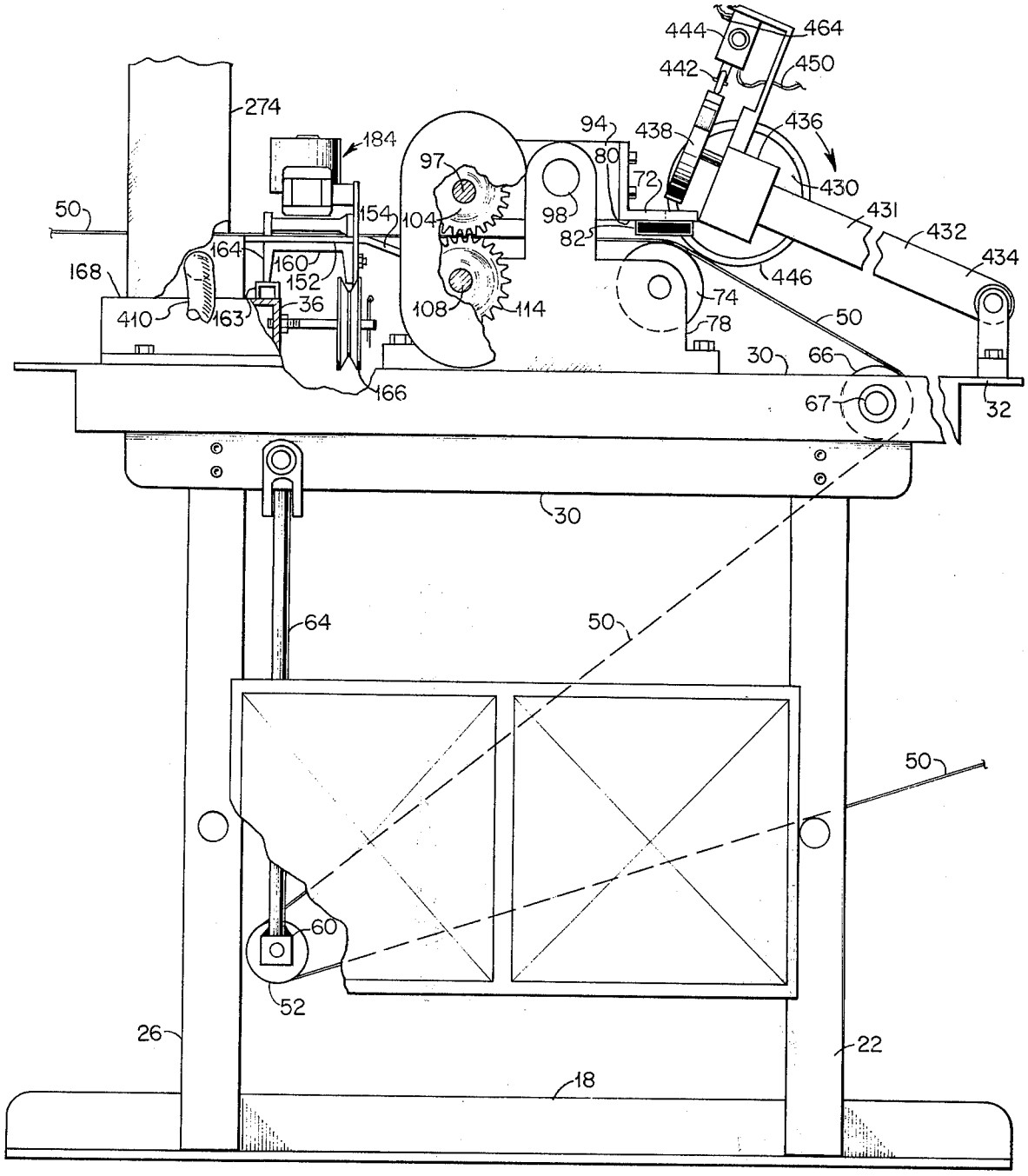

444
464
442
450
274
184
94
438
436
97
80
72
430
50
154
104
98
431
432
164
160
82
434
168
152
446
36
74
410
163
108
114
78
50
30
66
166
67
32
30
64
50
50
60
52
26
22
18

Fig. 2.

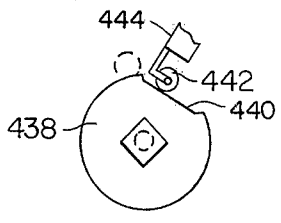

444
442
440
438

Fig. 2a

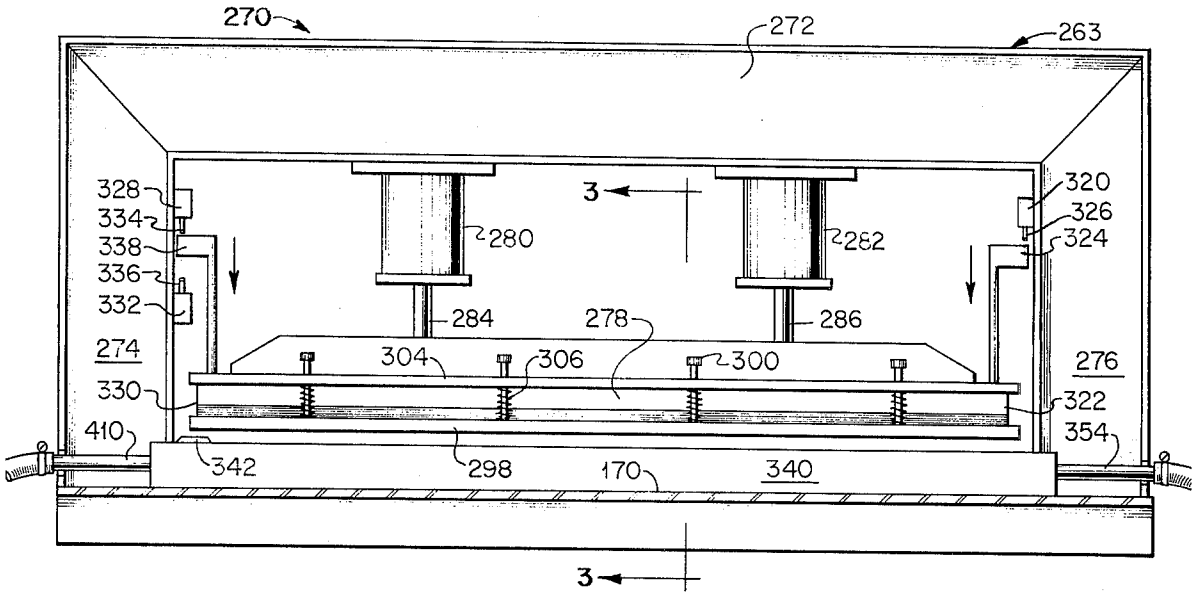


Fig. 4.

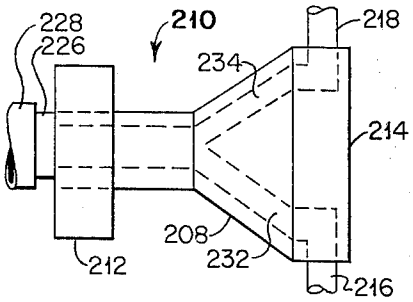


Fig. 16.

Fig. 3.

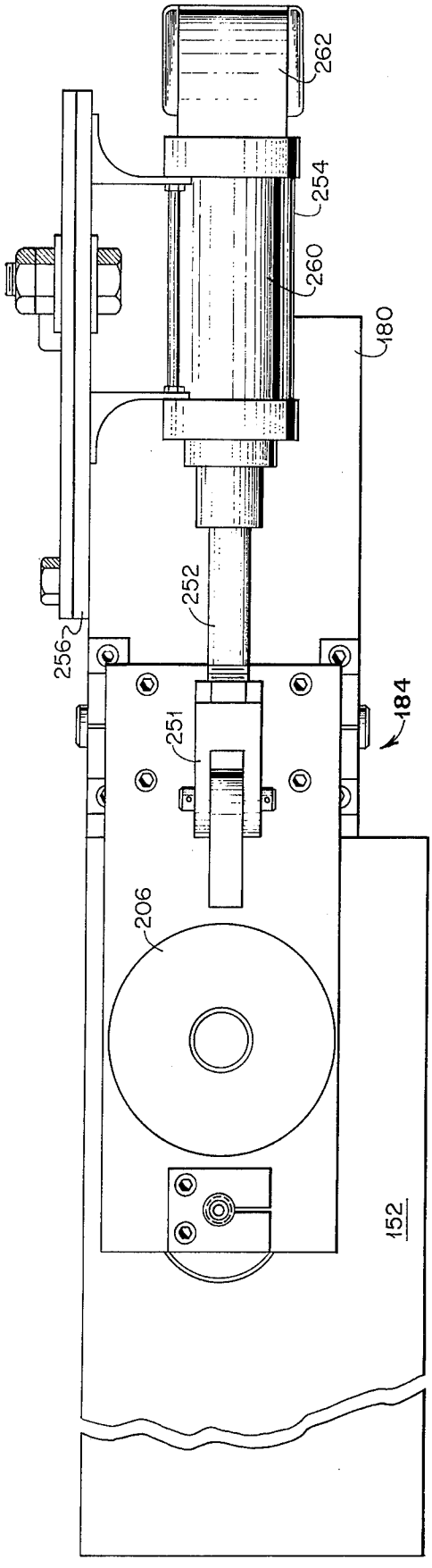


Fig. 6.

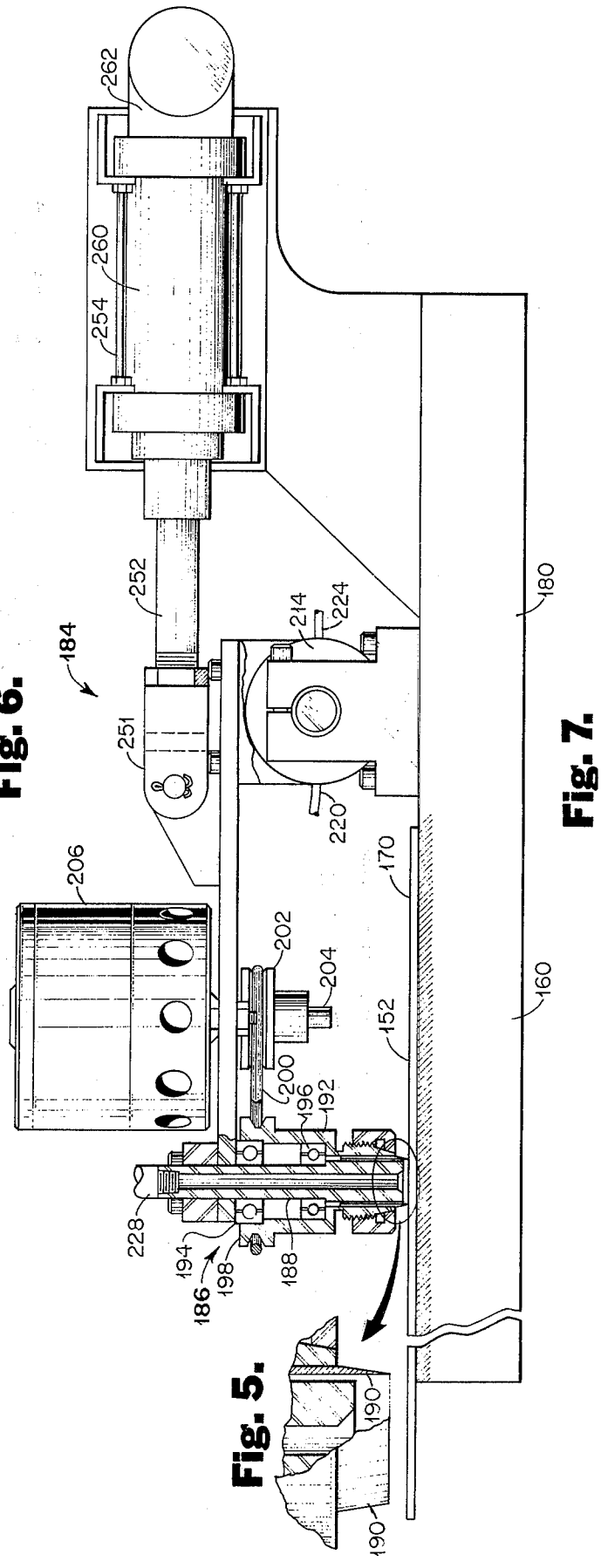


Fig. 7.

Fig. 5.

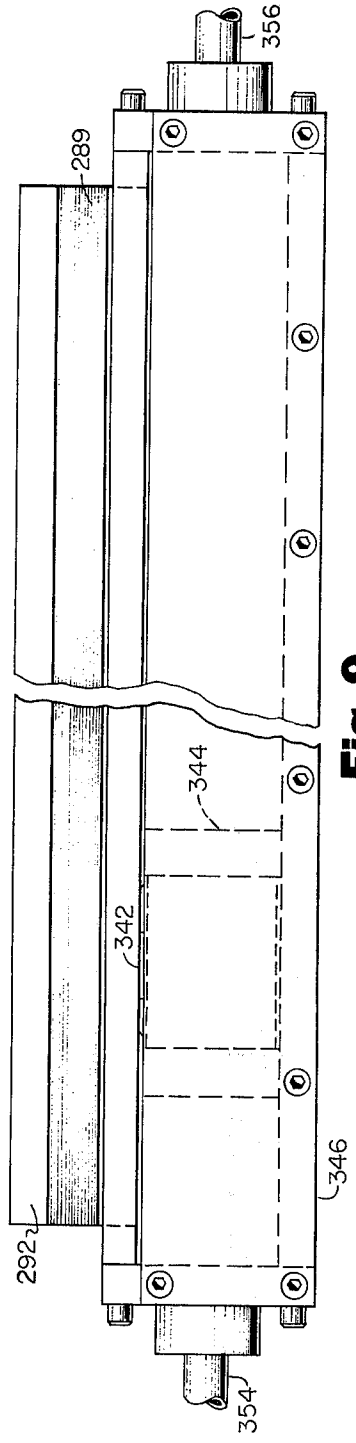


Fig. 9.

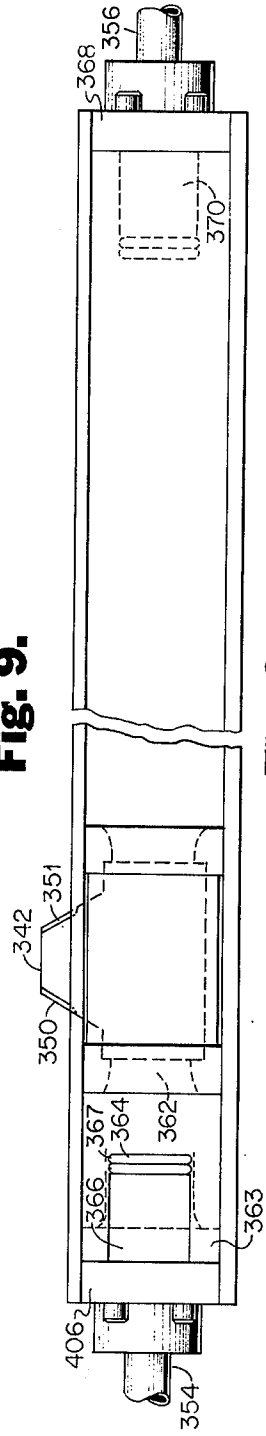


Fig. 8.

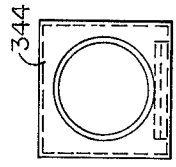


Fig. 13.

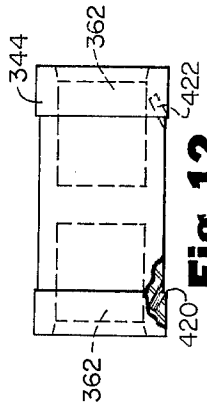


Fig. 12.

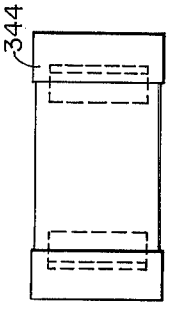


Fig. 11.

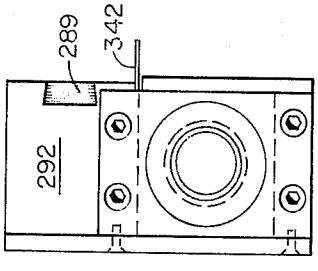


Fig. 10.

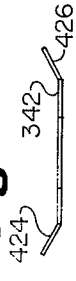


Fig. 15.

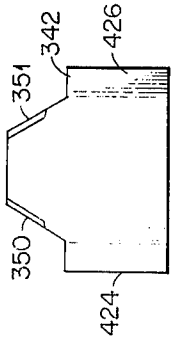


Fig. 14.

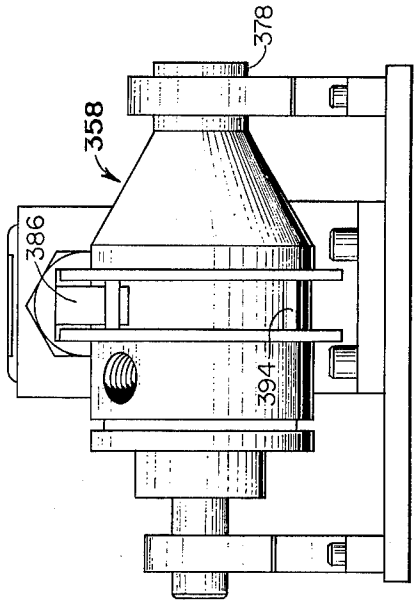


Fig. 21.

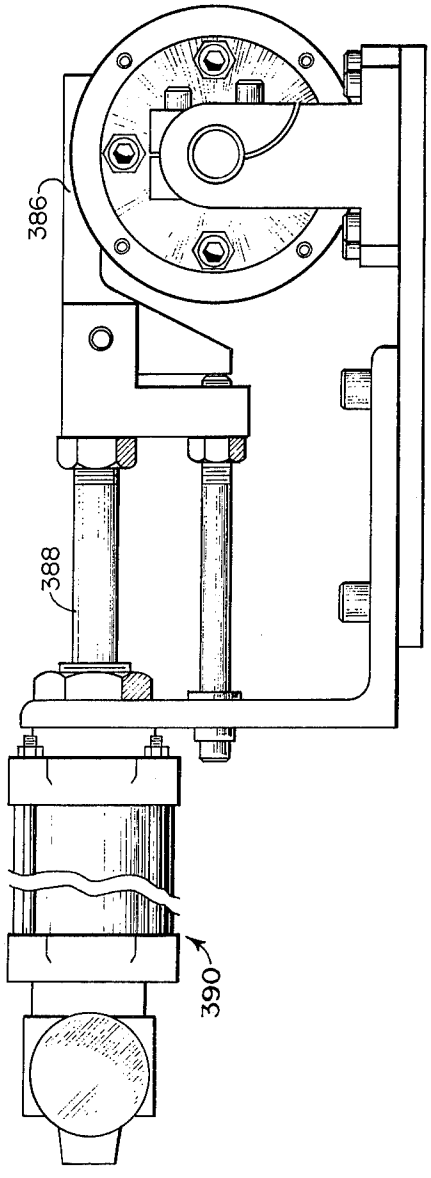


Fig. 20.

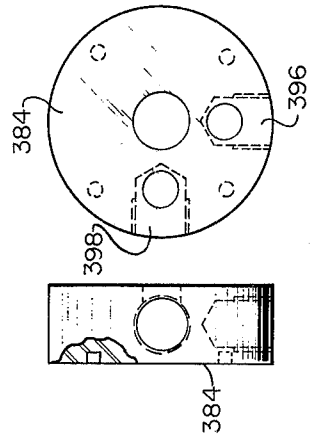


Fig. 19. Fig. 19a.

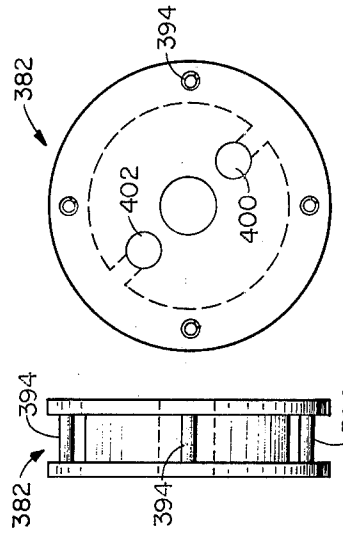


Fig. 18. Fig. 18a.

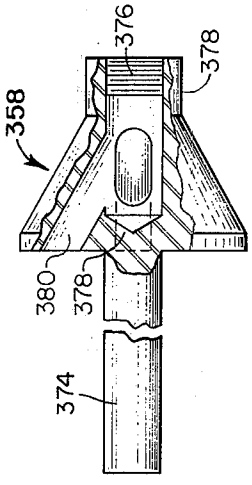


Fig. 17.

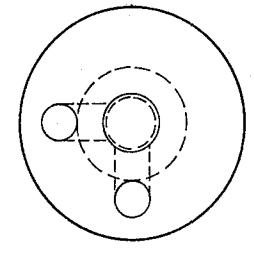


Fig. 17a.

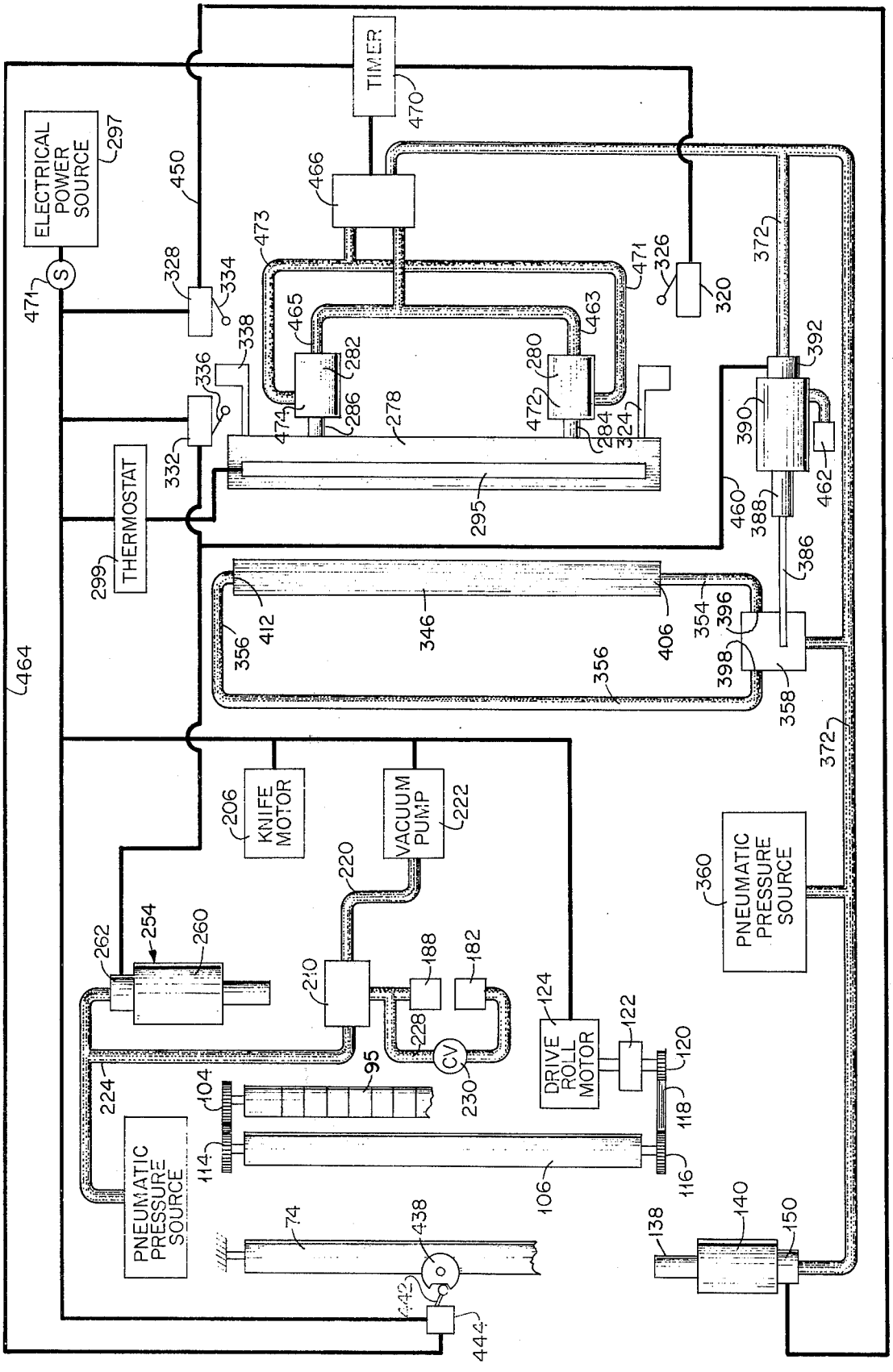

TIMER
470
ELECTRICAL POWER SOURCE
297
450
466
473
471
326
372
328
334
320
338
465
463
336
282
280
392
278
472
474
286
284
324
390
332
295
460
462
THERMOSTAT
299
388
386
412
346
406
354
396
356
398
358
464
372
206
KNIFE MOTOR
VACUUM PUMP
222
220
360
PNEUMATIC PRESSURE SOURCE
254
262
260
210
188
182
124
DRIVE ROLL MOTOR
122
228
CV
120
95
230
224
104
118
114
106
116
PNEUMATIC PRESSURE SOURCE
74
438
140
138
150
442
444

Fig. 22.

APPARATUS FOR THE MANUFACTURE OF DUNNAGE BAG LINERS

This invention relates to apparatus for the manufacture of inflatable liners for disposable dunnage bags.

Dunnage bags have been used heretofore to fill the unoccupied space in an incompletely filled truck or rail car, thereby preventing shifting of the partial load during transit. Because the size of such unoccupied space is not predeterminable prior to loading the vehicle, inflatable dunnage bags have been used as a means to fully occupy whatever space within the vehicle is vacant. Preferably, the dunnage bags are not reused inasmuch as they are prone to develop tears, rips or other points of weakness which pose potential rupture points during subsequent reuse and resultant loss of control over the load. Because the bags are intended to be used only once and thereafter disposed of, it is desirable that the cost of the bags be kept low.

One dunnage bag of the prior art comprises a multilayered kraft outer bag fitted with an inflatable liner or bladder disposed inside the kraft bag. To keep the cost of the dunnage bag low, the inflatable liner preferably is made from a thin-wall plastic, such as polyethylene having a wall thickness of about 4 to 6 mils. This sheet material is readily available in rolls of flattened tubing of indefinite length. Such flat sheet material comprises two flat layers overlying each other and joined to each other along their mutual side edges. When cut to suitable lengths, fitted with an inflation valve, and sealed at its ends, this material makes suitable liners for dunnage bags.

In the manufacture of a plastic liner for a dunnage bag, the thin wall of the plastic and its low friction coefficient makes it difficult to handle or manipulate, particularly when in flat sheet form. One particular problem is the tendency of the thin plastic sheet to wrinkle when it is attempted to move the sheet through an apparatus in a flat condition.

Further, in manufacturing dunnage bags having plastic liners, it has been found important to maintain the dimensions of the liner substantially identical to the inside dimensions of the kraft bag so that the liner fits snugly inside the kraft bag without wrinkles. When a liner is inflated, any wrinkles develop potential rupture points which could result in catastrophic failure of the bag during transit and resultant disastrous shifting of the load. Further, it is important that the inflation valve fitted in the liner be positioned precisely so that when the liner is inserted in the outer kraft bag, the valve will register with an opening in the wall of the kraft bag and the inflation valve will be exposed externally of the bag to permit subsequent inflation.

It is therefore an object of this invention to provide apparatus for the manufacture of an inflatable liner for a dunnage bag. It is another object of this invention to provide an apparatus for the manufacture of a dunnage bag liner which is flat, rectangular, of precise length and width dimensions, and for providing a precisely located opening in one wall of the liner for receipt of an inflation valve.

Other objects and advantages will be apparent from the following description, including the drawings, in which:

FIG. **1** is a representation of apparatus including various features of the invention;

FIG. **1***a* is a representation of a product produced by the apparatus of FIG. **1**;

FIG. **2** is an elevation view of the left side of the apparatus dipicted in FIG. **1**;

FIG. **2***a* is a fragmentary representation of a sheet material movement monitoring device;

FIG. **3** is a fragmentary sectional view, partly schematic, of sealing and cutting portions of the disclosed apparatus, including the drive rolls;

FIG. **4** is a fragmentary sectional view of a portion of the forward end of the apparatus depicted in FIG. **1**;

FIG. **5** is a fragmentary view of the cutting end of a rotary knife;

FIGS. **6** and **7** are side elevation and plan views, respectively, of one embodiment of a hole cutter device as disclosed herein;

FIG. **8** and **9** are a side elevation view, with one side plate removed, and a plan view, respectively, of a cutoff knife device as disclosed herein;

FIG. **10** is an end elevation view of the left end of the device depicted in FIG. **8**;

FIGS. **11**, **12** and **13** are side elevation, plan, and end views, respectively, of a block for holding a cutoff knife;

FIGS. **14** and **15** are side and top views, respectively, of a cutoff knife;

FIG. **16** is a representation of a rotary valve employed with the hole cutter depicted in FIG. **6**;

FIGS. **17**, **17***a*, **18**, **18***a*, **19**, **19***a*, **20**, and **21** depict a rotary valve employed in controlling the functioning of the cutoff knife depicted in FIGS. **8** and **9**; and,

FIG. **22** is a schematic representation of a control system, showing pneumatic and electrical features, for the apparatus depicted in FIG. **1**.

The disclosed apparatus includes means for storing and dispensing a supply of flattened tubular sheet material, means for feeding the sheet material in a flat condition forwardly from the storage means, means for monitoring the forward movement of the sheet and stopping such forward movement at predetermined intervals, means for severing the sheet material across its width when it is stopped, means for sealing one end of each severed section of tubular sheet material, and means for cutting an opening through one of the layers of the sheet material at a location adjacent the unsealed end of each severed section.

In the depicted embodiment, the apparatus includes frame means **10** having forward and rear ends **12** and **14** respectively. The sides of the frame include base members **16** and **18**, vertical members **20**, **22**, **24**, **26**, **28** and **30**. The opposite sides of the frame are joined to each other as by horizontal cross members **32**, **34** and **36**.

A pair of upright standards **38** and **40** are mounted on opposite sides of the rear end **14** of the frame base members **16** and **18**. The top end **42** of each standard is provided with a slot **44** defining a support for the spindle shaft **46** of a supply roll **48** of flattened tubular sheet material **50** disposed in a horizontal position and extending across the width of the frame in position to be passed through the apparatus.

A dancer roll **52**, journaled at its opposite ends **54** and **56** in the outboard ends **58** and **60** of a pair of arms **62** and **64** which are hingedly connected to the horizontal frame members **28** and **30**, extends across the width of the frame **10**. In this manner the dancer roll **52** is free to move in a generally arcuate path about the hinge axis of the arms **62** and **64** and, by virtue of its

weight, to maintain a downward pressure against the sheet material **50** when such sheet material is wrapped about the dancer roll as appears more fully hereinafter.

Above the dancer roll and rearwardly thereof there is provided an idler roll **66** including a shaft **67** rotatably mounted at its opposite ends **68** and **70** to the horizontal frame members **28** and **30** so that it extends across the width of the frame.

Above and forwardly of the idler roll **66,** there is provided a braking means comprising a brake roll **74** whose opposite ends are journaled in upright standards **76** anad **78** that are secured to the horizontal frame members **28** and **30,** respectively. The braking means further includes an elongated brake beam **72** which also extends across the width of the frame and substantially parallel to the brake roll **74.** This beam **72** includes a flat face **80** disposed above and, in juxtaposition to the brake roll **74,** the face **80** having mounted thereon a strip of friction material **82** facing the brake roll **74.** The opposite ends **84** and **86** of the beam **72** are secured to the ends **88** and **90,** respectively, of rocker arms **92** and **94** pivotally mounted by shafts **95** and **98** to the upright standards **76** and **78.** As thus mounted, the beam **72,** hence the friction strip **82,** is movable toward and away from the brake roll **74** upon movement of the rocker arms **92** and **94.**

A set of drive rolls is mounted on the frame at a location forwardly of the brake means, each of the rollers of the set being disposed horizontally across the frame. This set of drive rolls includes a friction drive roll **96** having a shaft **97** extending from opposite ends thereof and journaled at one end **99** in one end **100** of the rocker arm **92.** The shaft **97** is further journaled at its opposite end in the end **102** of the rocker arm **94** so that the friction drive roll **96** is translatable along a generally vertical path in response to rocking movement of the rocker arms **92** and **94.** The end **99** of the shaft **97** is further provided with a spur gear **104** fixedly mounted thereon.

The set of drive rolls further includes a smooth surface drive roll **106** having a shaft **108** extending from the opposite ends thereof, such roll being oriented substantially parallel to the friction drive roll **96** and in juxtaposition thereto to define a nip **110** therebetween. One end of the shaft **108** is journaled in the upright standard **76,** with the opposite end of the shaft **108** being journaled in the upright standard **78** disposed on the opposite side of the frame. The end of the shaft **108** extends laterally beyond its journaled mounting in the standard **78** and is provided with a spur gear **114** fixedly secured thereon. This gear **114** on shaft **108** is substantially identical in size to the gear **104** on the shaft **97** and meshes therewith so that the shafts turn simultaneously and in opposite direction when the gears **114** and **104** are rotated. The opposite end of the shaft **108** is provided with a further spur gear **116** which is drivingly connected by a drive chain **118** to a gear **120** on the output shaft (not visible) of a gear reducer **122** connected to a motor **124** such that operation of the motor functions to rotate the friction drive roll and the smooth surface drive roll in unison. In the preferred embodiment, the motor **124** operates continuously while the apparatus is functioning thereby continuously rotating the drive rolls. The limit of rocking movement of the rocker arms **92** and **94** which raises the friction drive roll **96** away from the drive roll **106** is less than that which will allow the gears **114** and **104** to move out of driving engagement therebetween so that when the friction drive roll **96** is raised, it continues to rotate.

Preferably the friction drive roll **96** is provided with a plurality of resilient circumferential friction rings **126** spaced apart substantially equal distances from each other along the length of the friction drive roll **96.** As depicted, each of the rings **126** preferably resides in a circumferential groove in the circumference of the roll **96** to aid in maintaining the relative spacing between the rings. The circumference of the friction roll **96** is chosen to be less than the circumference of the drive roll **106** by an amount such that when the rolls frictionally engage the sheet material between them and the resilient rings **126** are compressed, the circumference of the rings, as compressed, substantially equals the circumference of the drive roll **106** thereby providing for substantially equal tangential speeds of those surfaces of these two rolls that engage the sheet material. In this manner, the driving forces imparted to the top and bottom layers of the flattened tubular sheet material are substantially equal and the sheets are moved forwardly simultaneously. This structure and the use of multiple spaced apart friction rings has been found effective in preventing wrinkles in the bilayered sheet material when driving it forwardly through the apparatus. Further, the friction rings function to align the length dimension of the sheet material with the desired forward direction of travel through the apparatus.

Movement of the brake beam **72** and the friction drive roll **96** between their respective positions of engagement and disengagement with the sheet material fed through the apparatus is effected simultaneously by mounting these two elements on opposite ends of the rocker arms **92** and **94.** It is noted that when the brake beam is in its position of engagement, the friction drive roll is in its position of disengagement and vice versa. To effect movement of the rocker arms, the shaft **95** of the rocker arm **92** has fixedly secured thereto an elongated arm **128** that extends rearwardly from the shaft **95** and along the side of the frame **10.** The rear end **130** of the arm **128** is upturned and provided with an opening through which there is slidably received a rod **132.** A set screw **134** is provided to secure the rod **132** in a chosen position within the opening. The rear end of the rod **132** is pivotally connected to a clevis **136** mounted on the end of a piston **138** of a piston-cylinder **140** that is mounted on a plate **142** which is slidably received on a rail **144** whose opposite ends are mounted in blocks **146** and **148** secured to the frame member **28.** In this manner, the relative positions of the piston-cylinder **140,** the rod **132** and the arm **128,** are adjustable to select the distance between the shaft **95** and the piston **138** and thereby set the limits of rotation of the shaft **95** by vertical movement of the piston **138,** hence set the limits of the rocking movements of the rocker arms **92** and **94** to establish the desired positions of the brake beam **72** and the friction drive roll **96** relative to the brake roll **74** and the drive roll **106,** respectively. The depicted piston-cylinder **140** is single acting with its piston **138** spring-biased toward its retracted position. Admission of pneumatic pressure to the piston-cylinder **140** and exhausting the same is effected by a solenoid valve **150** interposed between the piston-cylinder **140** and a source of pneumataic pressure (See FIG. **22**).

A generally planar apron **152** is disposed across the frame in a generally horizontal plane with its leading edge **154** disposed adjacent the nip **110** between the drive rolls **96** and **106.** The apron **152** extends from the

nip of the drive rolls forwardly to define a flat smooth surface **156.** Preferably the leading edge **154** of the apron is inclined downwardly to guide the sheet material from the nip **110** onto the top surface **156** of the apron.

In the depicted embodiment the apron **152** is mounted on a slide beam **160** comprising an inverted "U" beam having depending longitudinal sides **162** and **164** extending along its length. One of the sides **162** is mounted in the circumferential groove of a pulley **166** that is rotatably mounted on the end of a shaft **165** mounted in the frame cross member **36.** The other longitudinal depending side **164** of the beam **160** is slidably received on a rail **163** disposed on the upper surface **168** of the frame cross member **36,** thereby slidably mounting the beam for movement in a direction transverse to the frame length.

Adjacent one end **180** of the beam **160** there is provided an openning **182** extending through the thickness of the beam and the overlying apron to define a vacuum port for the application of suction to the upper surface **170** of the apron. Further, on the end **180** of the beam **160** there is mounted a hole cutter **184** adapted to cut a circular opening in the top layer of the bilayered sheet material. As depicted in FIGS. **3, 6** and **7,** the hole cutter **184** comprises a cutting head **186** including a hollow tubular knife **188,** having one of its ends sharpened to define a circular cutting edge **190,** rotatably mounted in a housing **192** as by means of bearings **194** and **196.** The end of the knife **188** opposite the cutting end is provided with a sheave **198** fixed thereto and drivingly connected by a belt **200** to a sheave **202** fixed on the shaft **204** of a motor **206.** When the apparatus is in operation, the motor **206** runs continuously so that the cutting knife is rotating at all times.

The housing **192** holding the knife **188** is pivotally mounted on a shaft which forms a rotating member **208** of a rotary valve **210.** The shaft is rotatably mounted at its opposite ends in a pair of blocks **212** and **214** that are secured to the top **170** of the beam **160.** In this manner the housing **192** is adapted to be moved such that the cutting head **186** moves along the arcuate path toward and away from the sheet material disposed on the top of the apron **152.** One of the blocks **214** defines a stationary member of the rotary valve **210.** This stationary member is provided with two inlets **216** and **218,** one of which is connected by a conduit **220** to a vacuum pump **222** and the other of which is connected by a conduit **224** to a source of pneumatic pressure. The rotating member **208** of the rotary valve **210** is provided with an outlet **226** which is connected by means of a conduit **228** to the top end of the hollow knife **188** and to the bottom vacuum port **182** so that suction applied through the outlet **216** exerts its influence at the cutting edge of the rotary knife and at the bottom vacuum port. A check valve **230** is interposed in the conduit **228** to prevent the passage of pressurized air to the bottom vacuum port **182.**

The rotary member **208** of the rotary valve **210** is provided with openings **232** nd **234** therethrough at locations such that when the cutting knife is lowered to a position adjacent the sheet material, the opening **232** in the rotating member is aligned with the vacuum inlet **216** of the stationary member of the rotary valve thereby applying suction through the rotary valve and conduit **228** to the top and bottom layers of the sheet material. Upon movement of the cutting head away from the sheet material, the opening **232** in the rotating member **208** moves out of register with the vacuum inlet **216** thereby cutting off the vacuum and releasing the sheet material. As the cutting head **186** is further rotated, the opening **234** in the rotating member **208** comes into register with the pressure inlet **218** of the stationary member to admit pressurized air to the top end of the rotary knife **188** to blow the circular plug cut from the sheet material out of the rotary knife. Further upward movement of the cutting head moves the opening **234** out of register with the pressure inlet **218** to halt the flow of pressurized air through the rotary knife.

The housing **192** is further connected by a clevis **251** to the end of a piston **252** of a piston-cylinder **254,** the latter being mounted on an upstanding plate **256** secured to the side **162** of the beam **160** so that the hole cutter **184** is movable with the beam **160** in a direction transverse to the direction of forward movement of the sheet material through the apparatus. This freedon of movement of the hole cutter provides lateral adjustment of the cutting head relative to the edge **258** of the sheet material moving through the apparatus so that the location of the hole cut in the top layer of the sheet material will be located an exact distance inwardly of the sheet material from its edge **258.** Lateral freedom of movement of the hole cutter is made necessary by reason of the uneveness commonly found in the edges of a wound roll of sheet material. Being movable, the hole cutter may be moved in and out to follow the variable position of the edge **258** of the sheet material as the sheet material is moved through the apparatus. Such movement of the hole cutter may be effected manually or, if desired, provision may be made for automatically sensing the position of the edge of the sheet material and developing a signal to drive the beam **160,** hence the hole cutter **184,** in and out as required to follow the edge **258.**

The cylinder **260** of the piston-cylinder **254** is connected through a solenoid valve **262** to a source of pneumatic pressure. Upon opening of the solenoid valve **262,** and resultant extension of the piston **252,** the housing **192** is pivoted to lower the cutting head **186** to a position immediately above the sheet material. Upon closing of the valve **262,** the piston moves to its spring-biased retracted position to raise the cutting head **186** away from the sheet material.

Downstream from the hole cutter means there is provided a heat sealing means **263** extending across the frame **10** comprising a horizontal support beam **272** mounted at its opposite ends on the frame **10** by means of upright standards **274** and **276.** An elongated heat seal bar **278,** having a length at least equal to the width of the sheet material being processed, is connected to the beam **272** by means of a pair of double-acting piston-cylinders **280** and **282** which depend from the beam **272.** The piston members **284** anad **286** of the piston-cylinder units **280** and **282** are connected to the heat seal bar **278** at separated locations so that extension and retraction of the pistons **284** and **286** serves to lower and raise the heat bar relative to an elongated anvil member **289** disposed in top surface **290** of a bar **292** disposed across the frame **10** beneath the seal bar **278.** The seal bar **278** is of relatively narrow width and heated by means of a heater **295** inserted in the bottom edge **294** of the bar and extending along its length to provide substantially uniform heating of the bottom edge **294** of the bar. Electrical power for operating the heater **295** is fed from a source **297** of such power through a thermostat **299** to the heater.

The bar **278** is flanked on its opposite sides by clamp members **296** and **298**, one of which is spring mounted on each of the opposite sides of the heat seal bar as by bolts **300** threadably received in the top surface **302** of each clamp member **296** and extending upwardly therefrom to be slidably received in a ledge **304** extending horizontally from the side of the heat seal bar. Each of the clamps **296** and **298** is of substantially the same length as the heat seal bar **278** and extends substantially parallel therewith across the frame **10**. Spring means **306** is provided on each of the bolts **300** such that when the several springs are relaxed, the clamps **296** and **298** depend below the vertical level of the bottom edge **294** of the bar **278**. Upon movement of the bar into contact with the anvil member **289** disposed below the bar, the clamps are moved into alignment with the bottom of the seal bar, thereby expanding the springs **306** and biasing the clamps against the top surfaces of the bar **292** and the channel **340**.

A first switch means **320** is mounted on the upright standard **276** at a location above and adjacent one end **322** of the heat seal bar **278**. A first contact arm **324** mounted on the end of the heat seal bar engages a switch arm **326** of the first switch means **320** upon movement of the heat seal bar to its upper position. A second switch means **328** is mounted on the upright standard **274** at a location above and adjacent the opposite end **330** of the heat seal bar **278**. A third switch means **332** is also mounted on the upright standard **274** at a location above the heat seal bar, but below the second switch means **328**. Each of the second and third switch means includes a switch arm **334** and **336**, respectively. A contact arm **338** on the end **330** of the heat seal bar **278** is provided to engage the switch arm **336** of the third switch means **332** when the heat seal bar is in its lower position.

A cutoff knife **340** for severing the sheet material across its width is mounted on the frame **10** at a location adjacent to and rearwardly of the heat seal bar **278**. This cutoff knife comprises a double edges blade **342** secured to a slide block **344** which is slidably contained in a tubular channel **346** that extends across the frame **10** at a location rearwardly of the heat seal bar. The channel **346** is provided with a slot opening **348** through which the cutting edges **350** and **351** of the blade project to present the double cutting edge at a vertical level above the top **352** of the channel **346**. As seen in FIG. **3**, the slot **348** is located rearwardly of the seal bar **278** and forwardly of the clamp **298** so that when the seal bar and its clamps are lowered into engagement with the sheet material, the sheet material is secured held for the knife to make a cut across the width of the sheet material. Notably, this cut is made immediately rearwardly of the seal made by the seal bar **278** so that the forward cut edge of the sheet material defines one end **502** of the liner **500**.

The slide block **344**, hence the blade **342**, is moved along the length of the channel **346** preferably by pneumatic pressure. To this end, the channel **346** has connected to the opposite ends thereof conduits **354** an **356** that lead through a rotary valve **358** to a source **360** of pneumatic pressure. The block **344** is preferably of light weight construction, hence has substantial portions thereof cut away. In the preferred embodiment, each end of the block is provided with a closed bore **362** adapted to receive therein a hollow tubular piston member **364** mounted at the end of the channel **346** in horizontal alignment with the axis of the bore **362**. It will be recognized that when the block **344** moves into engagement with the piston **364**, as shown by the dotted line position of the block **344** in FIG. **8**, air is trapped in the annular space **363** between the outer wall of the piston **364** and the inner wall of the channel **346** and compressed to exert a braking effect upon the moving block. Preferably the piston member **366** is provided with an O-ring **366** encircling the piston adjacent its outboard end to insure adequate entrapment of air within the annular space **363**. The opposite end **368** of the channel **346** is provided with a like piston member **370** which functions to brake the block when it is moved in a direction toward the end **368** of the channel.

As visualized from FIG. **8**, when the hollow piston **364** resides in the bore **362** of the block **344**, pneumatic pressure admitted through the conduit **354** is initially captured in the bore **362** and effective against the bottom of the bore to impart a force against the block sufficient to propel it rapidly along the length of the channel **346**.

Referring to FIGS. **21** and **22**, the rotary valve **358** which controls the admission of pneumatic pressure to the ends of the channel **346** is connected by means of a conduit **372** to a source of pneumatic pressure **360**. The depicted rotary valve comprises an inlet member **374** having an internal bore **376** divided at one end of the member into two legs **378** and **380** which open inwardly of the valve. A central rotating member **382** is disposed between the inlet member **374** and a stationary outlet member **384** of the rotary valve. This central rotating member is adapted to be rotated about its axis by means of a pawl **386** attached to the piston **388** of a piston cylinder **390** whose actuation is controlled by a solenoid valve **392**. The pawl **386** engages cross rods **394** on the central rotating member **382** when the pawl is extended by the piston **388**. By design, each full extension of the piston **388** results in rotation of the rotary member **382** by one-quarter turn.

The valve **392** controlling the piston-cylinder **390** is connected by lead **322** to the switch **332** so that the electrical signal developed by this switch when the seal bar **278** is lowered causes the valve **392** to open and admit pneumatic pressure to the piston-cylinder **390**, extend the pawl **386** and rotate the central rotating member **382** of the rotary valve. Further, when the seal bar **278** is raised, the signal from the switch **332** causes the valve **392** to close, exhaust the pneumatic pressure and allow the piston **388** to retract the pawl **386** under the influence of a spring bias provided in the piston-cylinder **390**.

The stationary outlet member **384** of the rotary valve **358** is provided with openings **396** and **398** which register with openings **400** and **402** leading through the central rotary member **382** in preselected sequence, depending upon the rotational position of the central rotary member **382**, alternately admitting pressurized air from the inlet member **374**, through the central rotary member **382** to one of the outlets **396** and **398** of the outlet member **384**. The outlet **396** of the valve outlet member **384** is connected by conduit **354** to one end **406** of the channel **346**. The other of the outlets **398** is connected by a conduit **356** to the opposite end **412** of the channel **346** so that pressurized air for propelling the knife block **344** along the channel **346** is admitted first to one end of the channel to propel the knife along the length of the channel and perform a cut of the sheet material across its width, and thereafter is admitted to

the other end of the channel to reverse the direction of travel of the knife and thereby effect a cut of the sheet maerial in such reverse direction. By this means the knife is made to cut in both of its directions of travel.

The cutting blade **342** preferably is formed of relatively thin metal having a substantial spring constant. The depicted blade is substantially rectangular except that one long side has double tapered edges **350** and **351**, each of which is sharpened to define a cutting edge, so that the blade is capable of cutting when moved in either direction across the width of the frame **10**. To mount the blade in the block **344**, the block is provided with two parallel vertical slots **420** and **422** on one side of the block. These slots are spaced apart by a distance slightly less than the length of the blade **342**.

The blade is attached to the block by bending the blade, inserting its opposite ends **424** and **426** in the slots **420** and **422** and releasing the bending moment of the blade so that the blade springs back to hold itself in the slot.

FIGS. **2** and **2***a* depict a means for monitoring the lineal movement of the sheet material through the depicted apparatus and includes a metering wheel **430** rotatably mounted on the end **431** of an arm **432** whose opposite end **434** is pivotally hinged to the frame cross member **32** so that the metering wheel **430** may be moved along an arcuate path between positions of engagement and disengagement with sheet material wrapping the brake roll **74**. The metering wheel is connected through a gear box **436** to a cam **438** such that rotation of the metering wheel effects rotation of the cam. The cam **438** is provided with a notch **440** in its periphery for receiving the switch arm **442** of an electric switch **444**. Preferably the circumference of the wheel **430** is provided with a friction rim **446** to insure good driving contact between the wheel and the sheet material **50** as it moves over the roll **74** beneath the wheel. As will appear more fully hereinafter, when the sheet material is moved forwardly through the apparatus, the wheel **430**, by reason of its frictional engagement with the sheet material, is caused to rotate. This rotation of the wheel is transferred through the gear box **436** to the cam **438** to rotate the cam. Because of the direct connection between the metering wheel and the cam, each rotation of the metering wheel effects a predetermined degree of rotation of the cam with the result that through choice of the length of the circumference of the metering wheel, a predetermined length of sheet material may be moved through the apparatus per each rotation of the cam. Each rotation of the cam brings the notch **440** into register with the arm **442** of the switch **444** to cause the switch to open and close in response to the rotational position of the notch.

With reference to the schematic control system depicted in FIG. **22**, the switch **328** is connected by an electrical lead **450** to the solenoid valve **150**, which controls the actuation of the braking and drive piston-cylinder **140**, to provide an appropriate electrical signal to open the valve **150** when the arm **334** of the switch **328** is engaged by the contact **338** upon raising of the seal bar **278**, thereby admitting pneumatic pressure to the piston-cylinder **140** to extend the piston **138** and rotate the rocker arms **92** and **94** to move the brake beam **72** out of engagement with the sheet material wrapping the brake roll **74** and, simultaneously, to move the friction drive roll **96** into engagement with the sheet material, thus commencing forward movement of the sheet material through the apparatus. The valve **150** is closed to shut off the piston-cylinder **140** from the source of pneumatic pressure and permit the piston **138** to return, under the influence of its spring bias, to its retracted position, when the seal arm **278** is lowered and the contact **338** disengages the arm **334** of the switch **328**. This movement of the piston **138** results in movement of the rocker arms **92** and **94** to move the brake beam **72** to its engaged position and the friction drive roll **96** to its position of disengagement with the sheet material. Because the drive rolls continuously rotate, the sheet material immediately commences its forward movement when gripped in the nip **110** between the drive rolls upon the friction drive roll being moved to its position of engagement with the sheet material.

As noted above, the pneumatic pressure source **360** is further connected by a conduit **372**, through the solenoid valve **392**, to the piston-cylinder **390** which functions to rotate the central rotary member **382** of the rotary valve **358**. This solenoid valve **392** is connected by electrical lead **460** to the switch **332** so that the electrical signal developed by this switch, when its arm **336** is contacted by reason of the seal bar **278** achieving its lowered position, is fed to the valve **392** to open the valve and admit pressurized air to the cylinder **390** and extend the piston **388** to move the pawl **386** into contact with the central rotary portion of the rotary valve **358** and rotate such central portion one-fourth of a turn. In a preferred embodiment, the cylinder **390** is connected to a closed container **462** of adjustable volume, thereby causing the pressure within the cylinder **390** to increase rapidly initially and thereafter more slowly due to the restricted exhaust of cylinder **390**, with the result that the central rotary member **392** is turned first rapidly and then slowly through its one-fourth turn. This action provides for rapid movement of the central member **382** at the time of aligning one of its openings with an opening in the outlet member **384** thereby maximizing the rate of pressure rise in the channel **346** behind the block **344** to provide maximum propelling force to the block and the blade **342** carried thereon.

When the seal bar is raised the signal from the switch **332** to the valve **392** on piston-cylinder **390** is cut off causing this valve to close and exhaust the pressure from the piston-cylinder **390**, thus retracting the pawl **386** to a position suitable for subsequent reengagement with the rotary valve **358**.

Further, the electrical signal developed by the switch **444** when its arm **442** resides in the notch **440** of the cam **438** is fed by an electrical lead **464** to a timer **470**, which provides a signal to a solenoid valve **466** to open this valve and admit pneumatic pressure, by conduits **463** and **465**, simultaneously to the piston-cylinders **280** and **282** to lower the seal bar **278** against the sheet material disposed therebelow. When the timer **470** times out, it develops an electrical signal which serves to reverse the solenoid valve **466** and direct pneumatic pressure, by conduits **471** and **473**, to the bottom ends **472** and **474** of piston-cylinders **280** and **282** to raise the seal bar.

When the seal bar reaches its upper position, the contact **324** on the bar engages the arm **326** of the switch **320** and develops an electrical signal that is fed to the timer **470** to reset the timer.

In an operation of the depicted apparatus, the sheet material **50** is fed forwardly and downwardly from the supply roll **48** and wrapped around the dancer roll **52**, thence upwardly and rearwardly to partially wrap the

idler roll **70.** From the idler roll, the sheet is fed forwardly in partially wrapping engagement with the brake roll **74,** between the brake roll and the brake beam **72.** From the brake roll, the sheet material is fed forwardly through the nip **110** between the friction drive roll **96** and the smooth surface drive roll **106,** thence over the apron **152** and the top surface of the channel **346** to pass beneath the heat seal bar.

At the start of an operation of the disclosed apparatus, the friction drive roll **96** is in its upper position out of engagement with the sheet material, the heat seal bar **278** is in its upper position out of engagement with the sheet material, the brake beam **72** is engaged with the sheet material wrapping the brake roll **74,** and the metering wheel **430** is positioned with its rim **446** engaging the sheet material wrapped about the brake roll. Also, the pneumatic pressure in the source **360** is established and the timer **470** is timed out.

Upon actuation of the apparatus by closing an appropriate switch **471,** the control system of the apparatus is connected to a source of electrical power **297** and thereby energized, at the same time starting the motor **124,** the motor **206,** and the vacuum pump **222.** The motors **124** and **206** and the vacuum pump **222** run continuously during the operation of the apparatus. Energizing the system with the seal bar **278** raised and the contact **338** engaging the arm **334** of the switch **328** functions to supply an electric signal appropriate to open the solenoid valve **150** to actuate the piston-cylinder **140** and move the friction drive roll **96** into engagement with the sheet material, while simultaneously raising the brake beam **72** and releasing the sheet material for movement through the apparatus.

As the sheet material moves through the apparatus, the metering wheel is rotated, resulting in rotation of the cam **438.** After the desired length of sheet material has passed through the apparatus, the arm **442** of the switch **444** falls into the notch **440** on the cam to develop an electric signal which actuates the timer, hence the solenoid valve **466** to admit pneumatic pressure to the piston-cylinders **280** and **282** to lower the heat seal bar **278,** and its flanking clamps **296** and **298,** into engagement with the sheet material disposed beneath the heat seal bar. When the heat seal bar moves downward and the contact **338** disengages the arm **334** of the switch **328,** the valve **150** closes and deactivates the piston-cylinder **140** to raise the friction drive roll out of engagement with the sheet material and lower the brake beam into engagement with the sheet material to stop forward movement of the sheet material through the apparatus.

As noted above, when the seal bar reaches its lowered position, the contact **338** actuates the switch **332** to develop a signal which actuates the valve **392** controlling the piston-cylinder **390** that turns the central rotating member **382** of the rotary valve **358** to admit pneumatic pressure to one end of the channel **346** to propel the cutoff knife along the length of the channel and sever the sheet material while it is stopped.

The signal from the switch **332** further serves to open the solenoid valve **262** to admit pneumatic pressure to the piston-cylinder **254** and move the cutting head **186** into position adjacent the top layer of the bilayered sheet material disposed on the top surface **170** of the slide beam **160.** As noted hereinbefore, as the rotary cutting head moves into position adjacent the sheet material, it rotates the rotary valve **210** to apply suction to both the bottom and top layers of the sheet material disposed between the two vacuum heads. Upon the application of the suction, the bottom layer of the sheet material is pulled downwardly against the top surface **170** of the apron **152** and the top layer of the sheet material is pulled into engagement with the rotating cutting knife **188** to cause the knife to cut a circular plug from the top layer of the sheet material.

The timer **470** is set to time out after the heat seal bar has been in contact with the sheet material for a time sufficient to effect a heat seal of the top layer of the sheet material to the bottom layer. When the timer times out, it provides a signal to the solenoid valve **466** causing it to exhaust pneumatic pressure from the top ends of the piston-cylinders **280** and **282** and simultaneously admit pneumatic pressure to the bottom ends of these piston-cylinders to move the heat seal bar to its upper position out of engagement with the sheet material. This movement of the seal bar **278** disengages the contact **338** from the switch **332** to cut off the signal to the solenoid valve **262,** causing this valve to close the exhaust the pneumatic pressure from the piston-cylinder **254** to raise the cutting head away from the sheet material. As the cutting head **186** is swung upwardly, it rotates the rotary valve **210** to sequentially close off the vacuum and momentarily admit pneumatic pressure through the central bore of the cutting knife **188** to expel the plug that was cut from the sheet material. The check valve **230** interposed in the conduit **228** functions to prevent the flow of pressurized air to the bottom vacuum port **182.** As the cutting head is swung further upwardly, the rotary valve is turned to close off the pneumatic pressure source from the hollow knife **188.**

Upon the heat seal bar **278** reaching its upper position, the contacts **324** and **338** engage the arms **326** and **334** of the switches **320** and **328,** respectively, to reset the timer to open the valve **150** to admit pneumatic pressure to the piston-cylinder **140** for releasing the brake beam and moving the friction drive means to contact with the sheet material for commencing a further cycle of operation.

Each severed length **500** of tubular sheet material (see FIG. **1***a*), having one of its ends **502** sealed and provided with an opening **504** in one of its layers is manually removed from the apparatus to a subsequent processing station. As noted hereinbefore, each liner is fitted with an inflation valve. This inflation valve is put in place after the liner has been severed by the disclosed apparatus so that it is necessary that one end of each severed length of sheet material remain open to permit access to the inside of the liner for fitting the inflation valve in the liner. To this end, the disclosed apparatus provides for positioning the hole cutter **184** adjacent to the cut-off knife **340** and rearwardly therefrom to thus position the opening **504** a proper distance to the rear of the unsealed cut end **506** of each severed length of sheet material. Similarly, the cut-off knife **340** is positioned rearwardly of the heat seal bar **278,** between the hole cutter and the seal bar, to sever the sheet material across its width at a location rearwardly of and adjacent to the seal **508** across the sheet material.

Liners, as depicted in FIG. **1***a*, are produced at a rapid rate, hence at a relatively low unit cost, employing the disclosed apparatus. By reason of the ability of the apparatus to rapidly move the bilayered sheet material through the apparatus without developing wrinkles in one or both layers and/or without buckling the sheet material, the length of each liner is precisely measured and the location of the hole for the inflation valve is

precisely positioned. It has been found that the percentage of liners rejected due to apparatus failure, malfunction, etc. is essentially nil.

While a preferred embodiment has been shown and described, it will be understood that there is no intent to limit the invention by such disclosure, but rather, it is intended to cover all modifications and alternate constructions falling within the spirit and scope of the invention as defined in the appended claims.

What is claimed:

1. In an apparatus for the manufacture of an inflatable liner for a dunnage bag employing a supply of flattened tubular sheet material of indeterminate length that exceeds its transverse dimension the improvement comprising in combination

frame means,

drive roll means adapted to move said sheet material forwardly through said apparatus in a flat condition when in engagement with said sheet material,

means adapted to rotate said drive roll means,

brake means adapted to stop movement of said sheet material through said apparatus when in engagement with said sheet material,

rocker means connecting said drive roll means and said brake means,

means connected to said rocker means and adapted to impart a rotating motion to said rocker means whereby said drive roll means and said brake means are moved alternately into engagement with said sheet material,

monitor means adapted to monitor the forward movement of said sheet material through said apparatus and actuate said means adapted to rotate said rocker means upon the passage of a predetermined length of sheet material past said monitor means to stop said sheet material,

sealing means adapted to contact said sheet material and effect a seal between the two layers of said sheet material and extending fully across the width of said sheet material,

first cutter means disposed at a location rearwardly of and adjacent to said sealing means and adapted

to sever said sheet material in a line across its width when said sheet material is stopped, said line of severance being substantially parallel to said seal, and

second cutter means disposed rearwardly of said first cutter means and adapted to cut an opening in the wall of said sheet material adjacent the unsealed leading end of said sheet material.

2. The apparatus of claim **1** and including means adapted to maintain said sheet material taut as it passes through said apparatus.

3. The apparatus of claim **1** wherein said drive roll means includes a friction drive roll means having a plurality of friction rings disposed about its circumference at locations spaced along the length of said roll.

4. The apparatus of claim **3** and including a further smooth surface drive roll means disposed in alignment with said friction drive roll means and defining a nip therebetween.

5. The apparatus of claim **4** and including means connecting said friction drive roll means and said smooth surface drive roll means to one another for simultaneous rotation thereof.

6. The apparatus of claim **1** wherein said brake means includes a brake roll that is partially wrapped by said sheet material and an elongated friction means disposed in alignment with said brake roll and adapted for movement between positions of engagement and disengagement with said sheet material wrapping said brake roll.

7. The apparatus of claim **1** and including piston-cylinder means having the piston member thereof connected to said rocker means for rotating said rocker means upon extension and retraction of said piston member, and means adapted to activate said piston-cylinder means.

8. The apparatus of claim **1** wherein said monitor means comprises a metering wheel frictionally engaging said sheet material as it moves through said apparatus, cam means rotatably connected to said metering wheel, notch means in the periphery of said cam means, and switch means including a switch arm engaging said cam means and adapted to activate said switch means when said switch arm enters said notch.

9. In an apparatus for the manufacture of an inflatable liner for a dunnage bag employing a supply of bi-layered sheet material of an indeterminate length that exceeds its transverse dimension the improvement comprising in combination

frame means,

sheet material supply means connected to said frame means and adapted to store a supply of said sheet material in position for dispensing said sheet material for forward movement through said apparatus,

first roll means disposed transverse to the forward direction of said material and adapted to receive said sheet material in partial wrapping engagement therewith,

friction means disposed in juxtaposition to said first roll means and adapted to move between positions of engagement and disengagement with said sheet material wrapped about said first roll means,

drive means adapted to progress said sheet material in its forward direction of movement, said drive means including

friction drive roll means and a further drive roll, each disposed transverse

to the forward direction of movement of said sheet material and defining a nip therebetween for frictionally receiving said sheet material therein and

means mounting said friction roll means for movement between positions of engagement and disengagement with said sheet material in said nip,

means adapted to rotate said friction drive roll means whereby said sheet material is moved forwardly through said nip when said friction roll means is in its position of engagement with said sheet material,

means monitoring the forward movement of said sheet material and adapted to provide a signal upon the passage of a predetermined length of sheet material past a preselected location on said apparatus,

means connecting said means mounting said firction drive roll means to said friction means, said connecting means adapted to move said friction means to its position of disengagement with said sheet material wrapped about said first roll means and synchronously move said friction drive roll means to its position of engagement with said sheet material when said connecting means is activated,

sheet cutter means mounted on said frame means and adapted to sever said sheet material transversely of its direction of forward movement upon actuation thereof,

sealing means disposed at a location upstream from and adjacent to said cutter means and extending trans-

verse to the forward direction of said sheet material,

means adapted to move said sealing means between a position of engagement with said sheet material for effecting a seal between the overlying layers fully across their width dimension, and a position of disengagement with said sheet material,

control means including means adapted to provide a first signal upon said sealing means engaging said sheet material and means adapted to provide a second signal upon the completion of a seal across said sheet material,

means adapted to receive said signal provided by said monitor means and in response thereto to activate said connecting means to move said friction means to its position of engagement with said sheet material and to move said friction drive roll means to its position of disengagement with said sheet material to stop the forward movement of said sheet material, and to receive said second signal provided by said control means and in response thereto to activate said connecting means to move said friction means out of engagement with said sheet material and to move said friction drive roll into engagement with said sheet material to commence forward movement of said sheeet material,

further means adapted to receive said first signal provided by said control means and in response thereto to actuate said cutter means to sever said sheet material while said sheet material is stopped,

hole cutter means located between said sheet cutter means and said drive means and including

suction means disposedd adjacent each of the opposite flat surfaces of said sheet material, the lower one of said suction means adapted to attract and hold the bottom layer of said sheet material thereagainst upon the application of suction therethrough, the upper one of said suction means adapted to attract the top layer of said sheet material thereagainst,

cutter means adapted to cut a plug from one of said layers while it is held by said suction means and thereby provide an opening through said layer suitable for receipt of an inflation valve, and

means adapted to expel said plug from said cutter means at a location remote from said sheet material, and

means adapted to apply suction to said suction means and

means adapted to activate said hole cutter means when said sheet material is stopped.

* * * * *