United States Patent

Glaze, Jr.

[15] **3,704,565**

[45] **Dec. 5, 1972**

[54] **METHOD OF AND APPARATUS FOR PRODUCING HOSIERY**

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[73] Assignee: **Intech Corporation,** 2

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[52] **U.S. Cl.**.....**53/21 FW,** 53/24, 53/117, 53/124 D, 206/45.31, 206/72, 214/8, 214/152, 223/75, 223/112, 302/2 R

[51] **Int. Cl.**.....**B65b 63/04,** B65b 63/02

[58] **Field of Search**.....53/21 FW, 24, 116, 117, 115, 53/124 D

[56] **References Cited**

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Primary Examiner—Travis S. McGehee

Attorney—Beveridge & De Grandi

[57] **ABSTRACT**

A method of an apparatus for shaping and inspecting hosiery articles on a form, automatically stripping the articles from the form, and conveying the stripped articles selectively to either a stacking apparatus where successive articles are automatically stacked in superimposed flat relation or to a packaging apparatus where the successive articles are automatically packaged. Individual components of the apparatus may be employed separately to perform individual functions, or collectively in an overall system.

37 Claims, 19 Drawing Figures

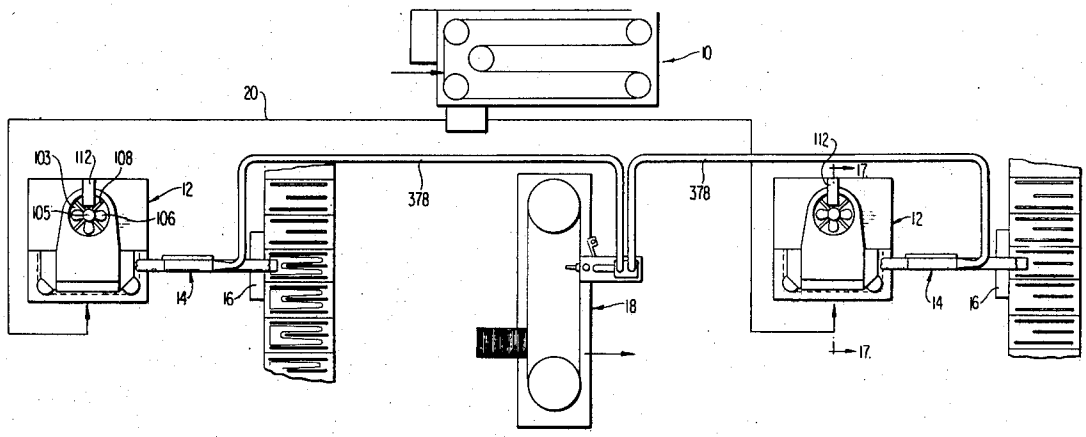
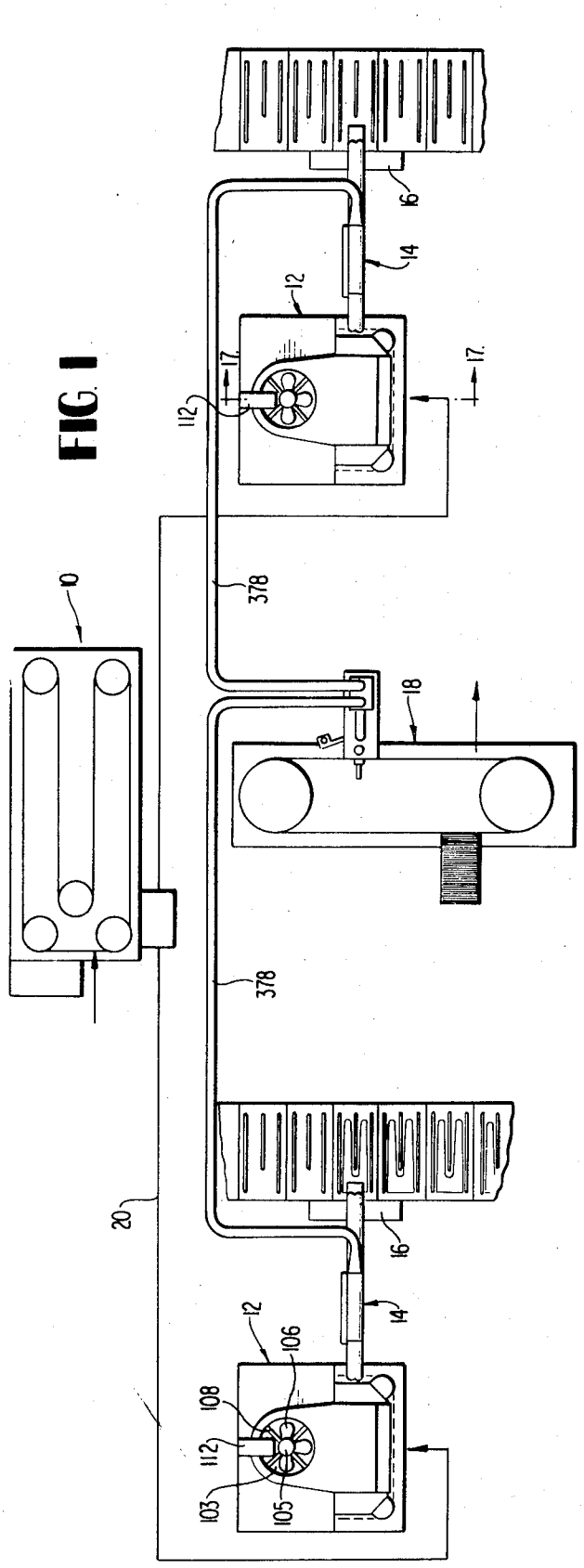


FIG. 1


10
12
14
16
17
17
18
20
103
105
106
108
112
112
378
378
378

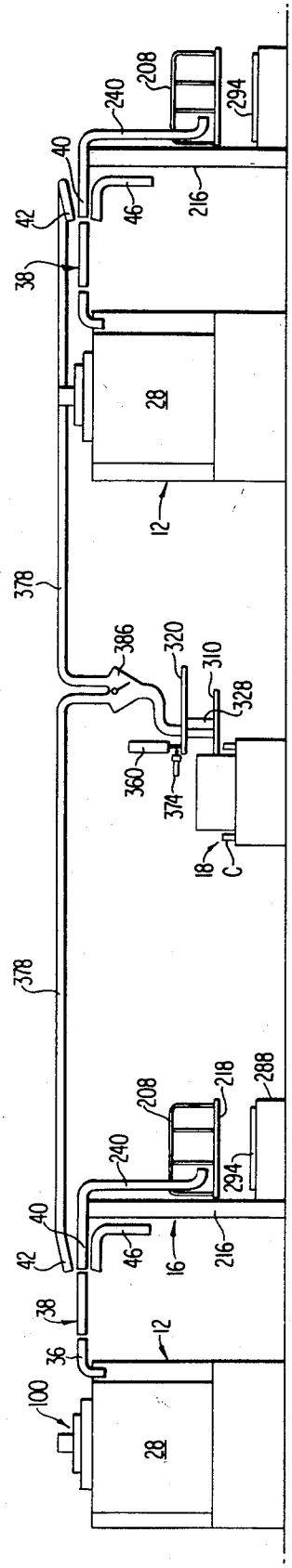

12
16
18
28
28
36
38
40
42
46
100
208
208
216
216
218
240
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288
294
294
310
320
328
360
374
378
378
378
386
C

FIG. 2

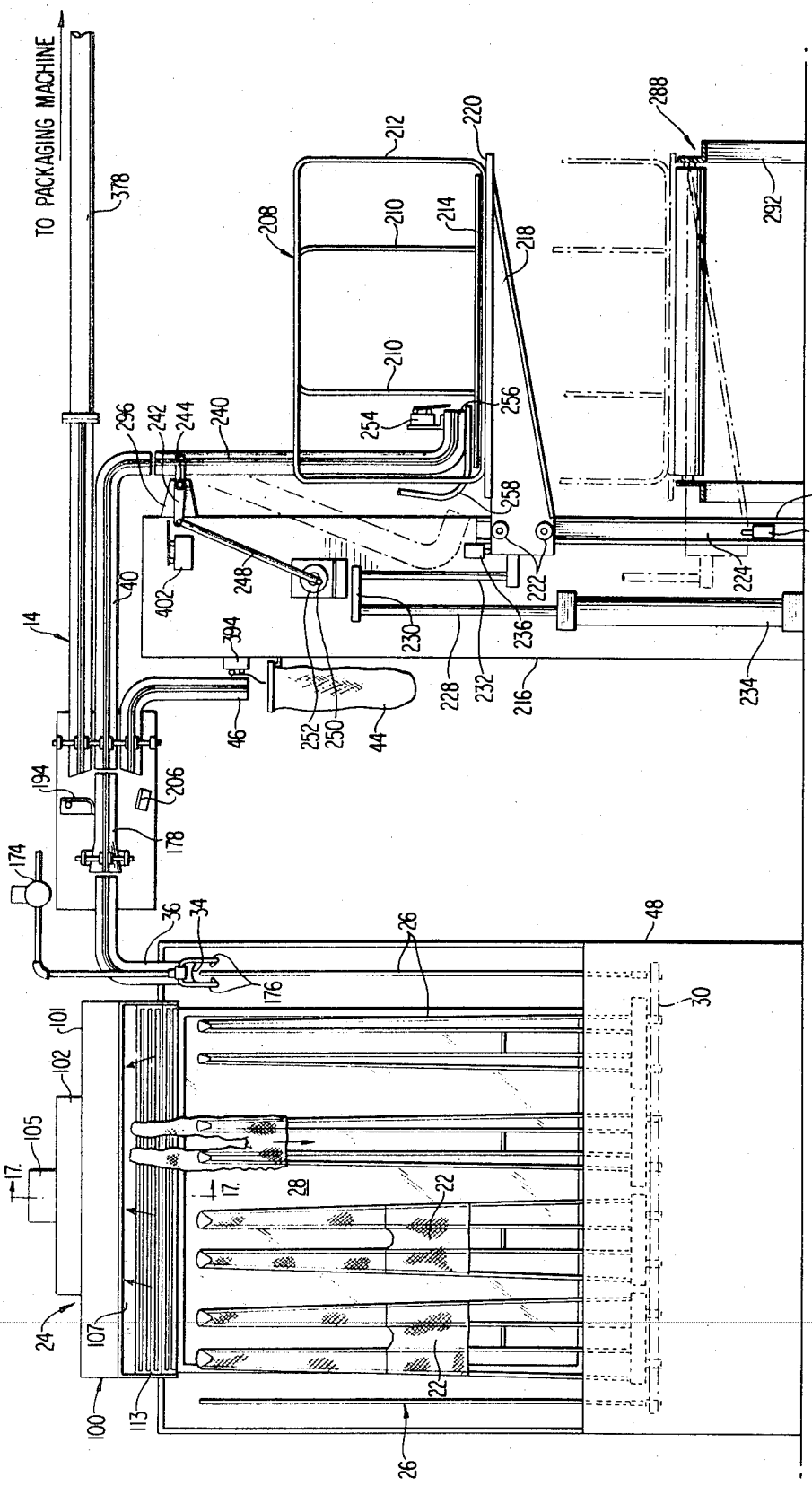

TO PACKAGING MACHINE
378
208
210
212
214
220
218
288
292
296
242
244
240
254
256
258
226
238
224
222
248
402
40
14
394
230
236
228
232
216
234
46
252
250
44
194
206
178
174
36
34
176
26
48
30
101
102
105
17
28
22
24
107
100
113

FIG 3

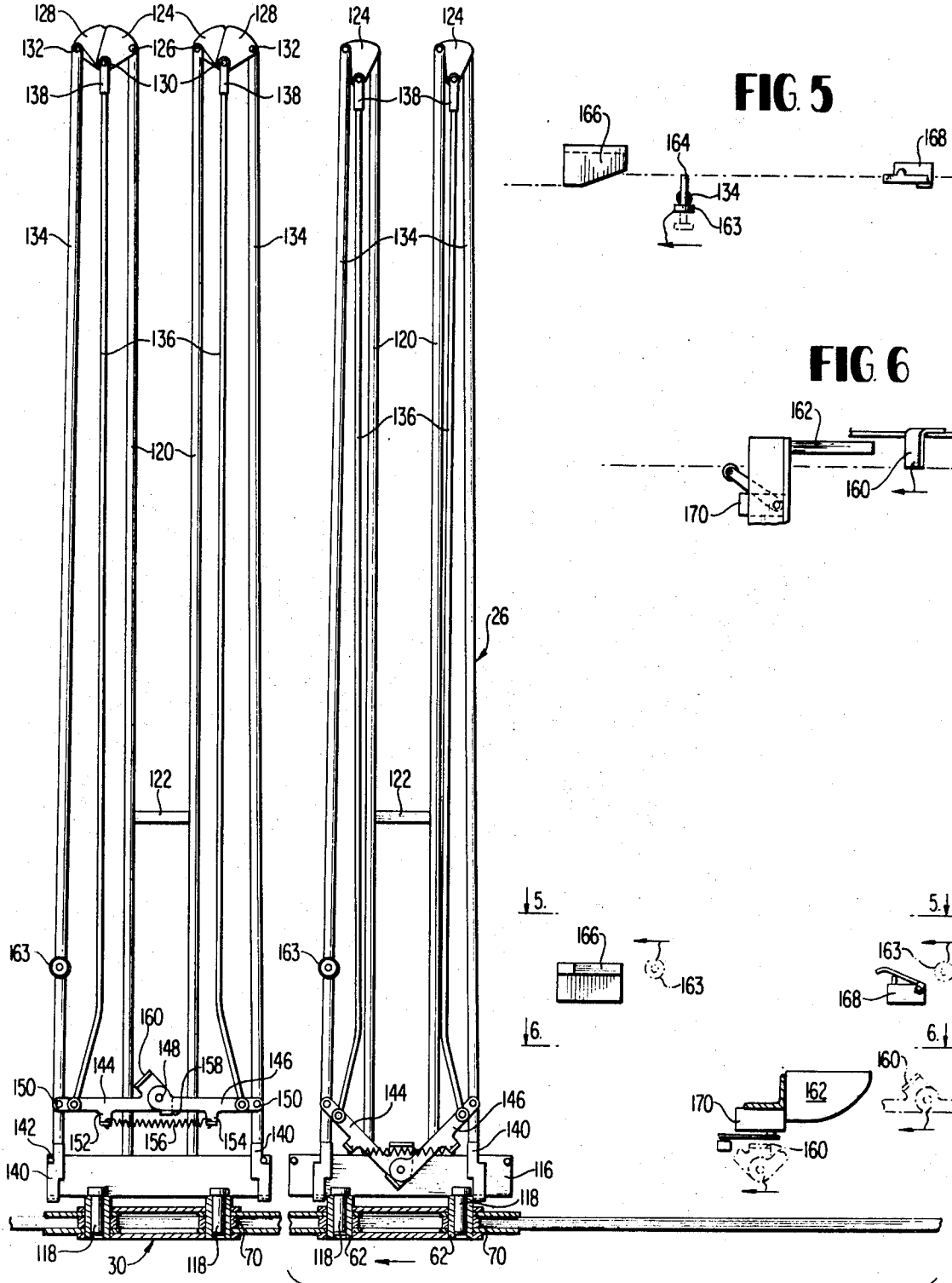


FIG. 7

FIG. 5

FIG. 6

FIG. 4

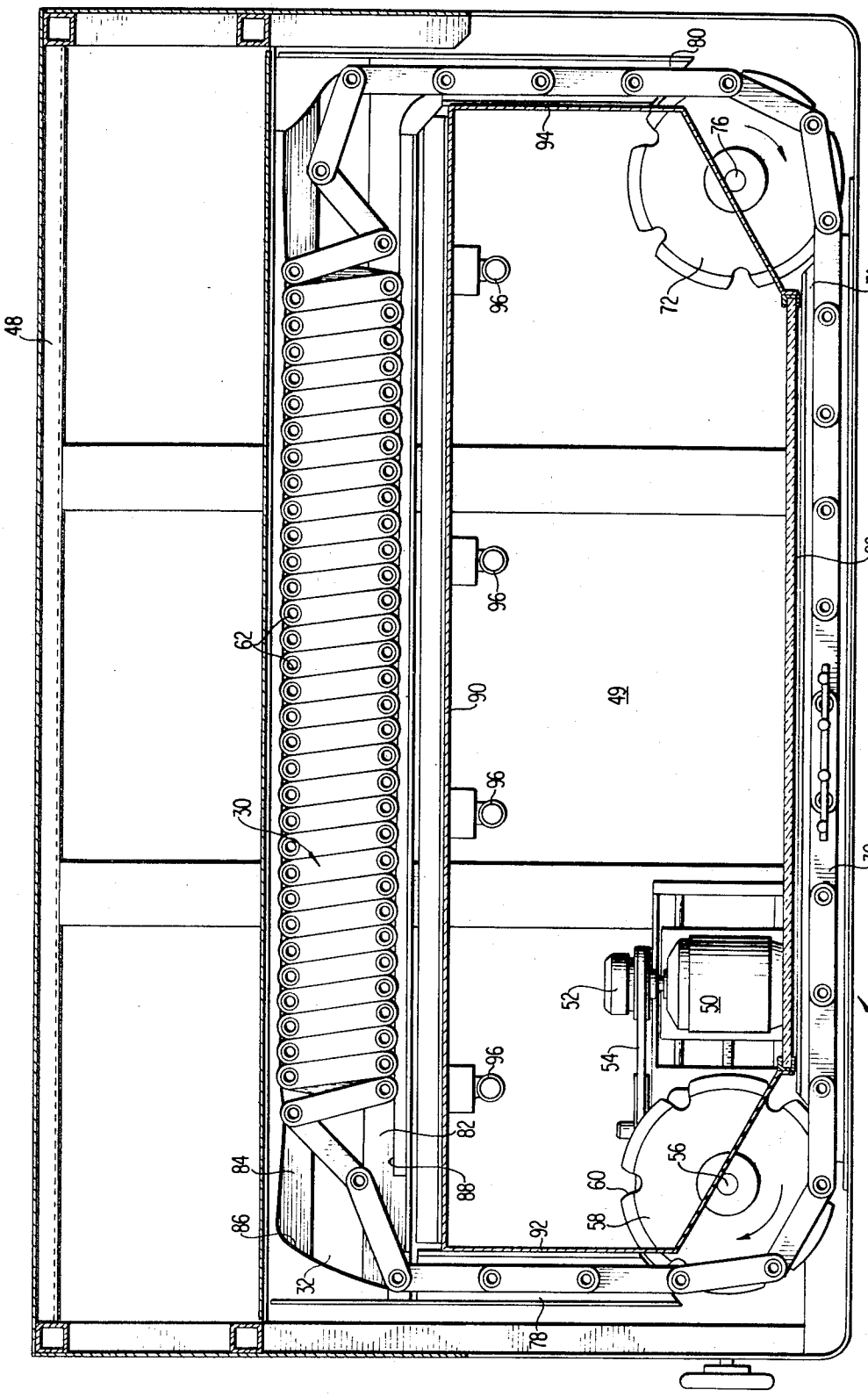

48
80
94
76
96
72
74
28
62
90
49
96
30
30
52
50
54
96
12
82
84
88
56
60
86
58
92
32
78

FIG 8

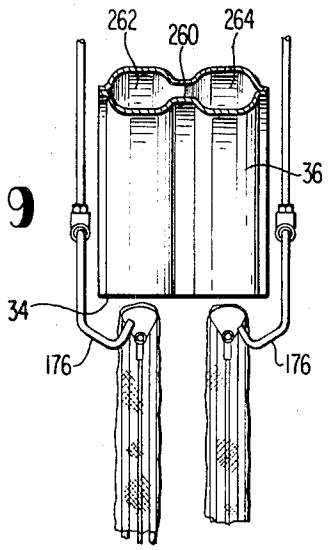


FIG. 9

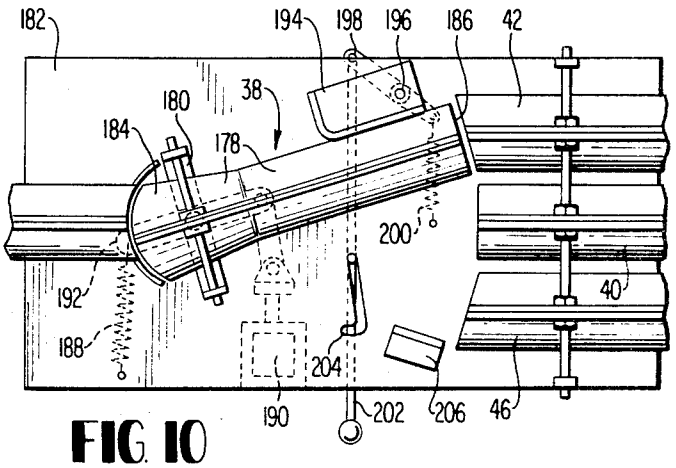


FIG. 10

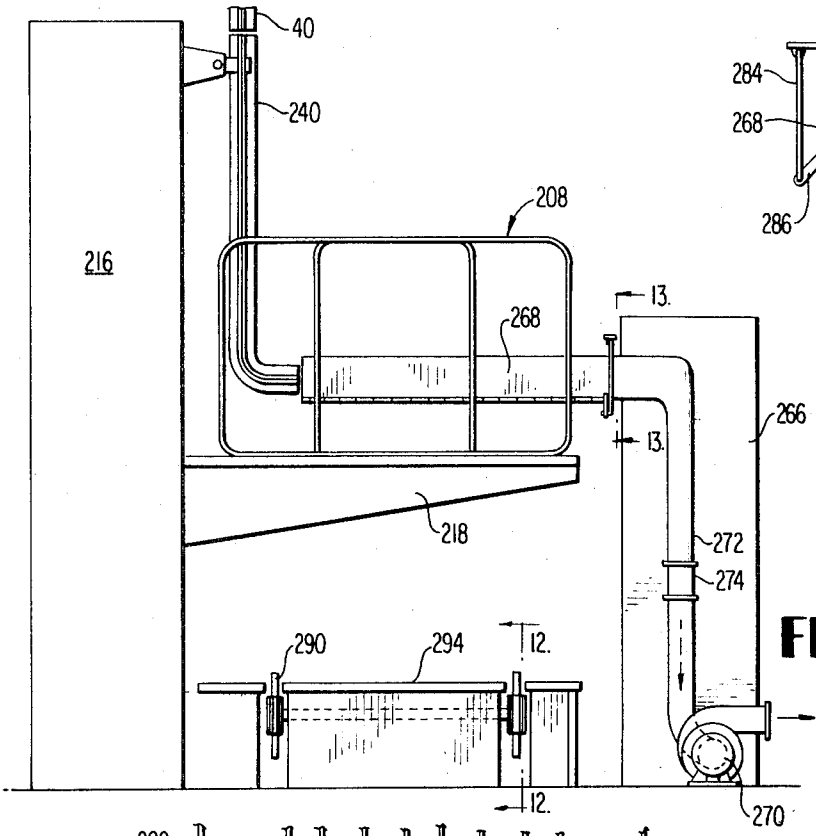


FIG. 11

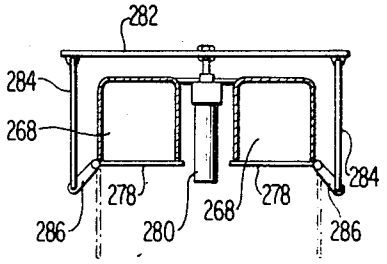


FIG. 13

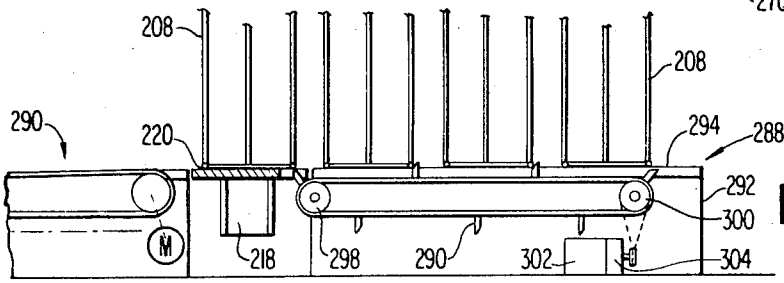


FIG. 12

FIG. 14

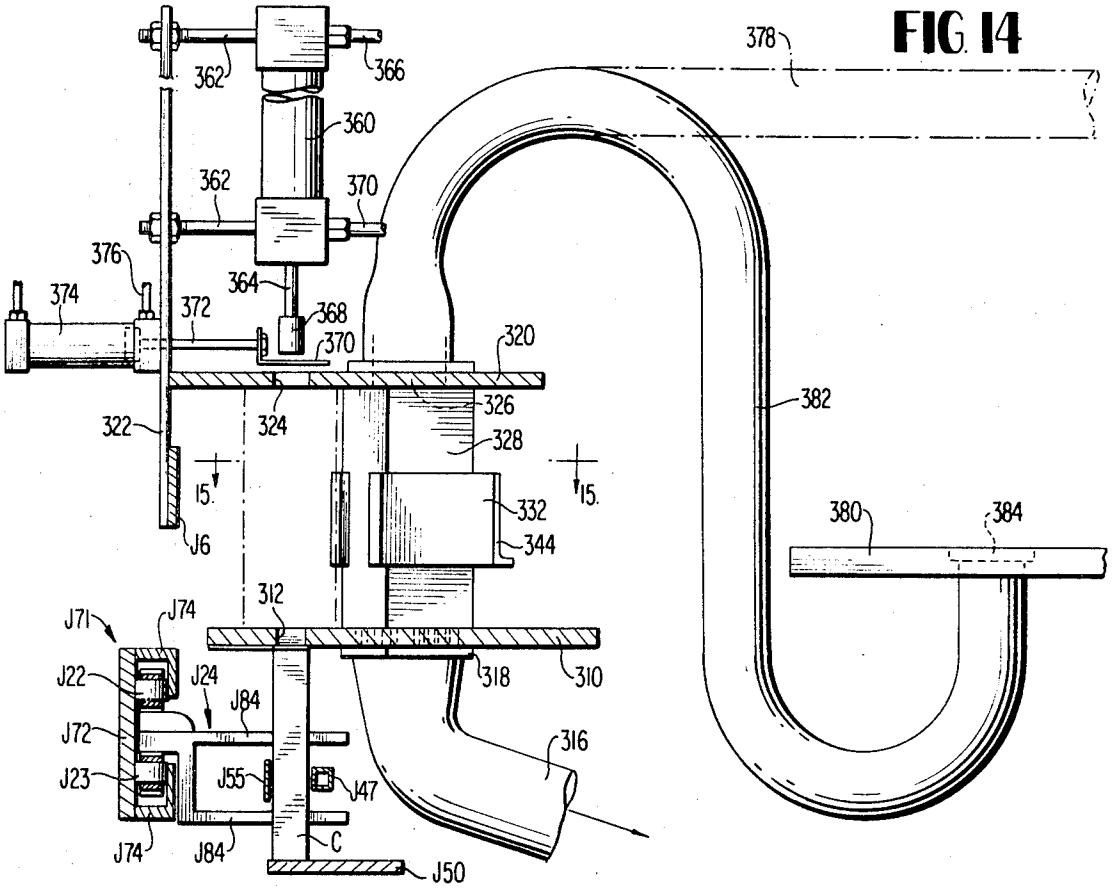


FIG. 15

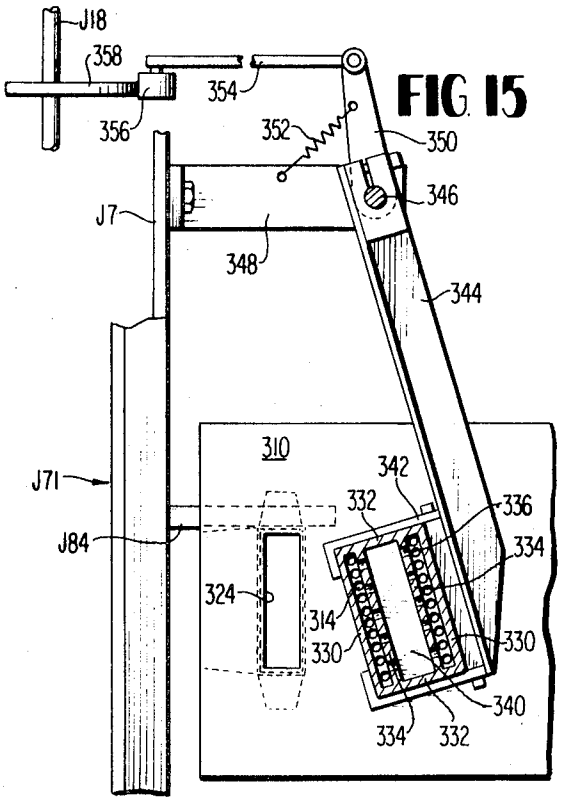
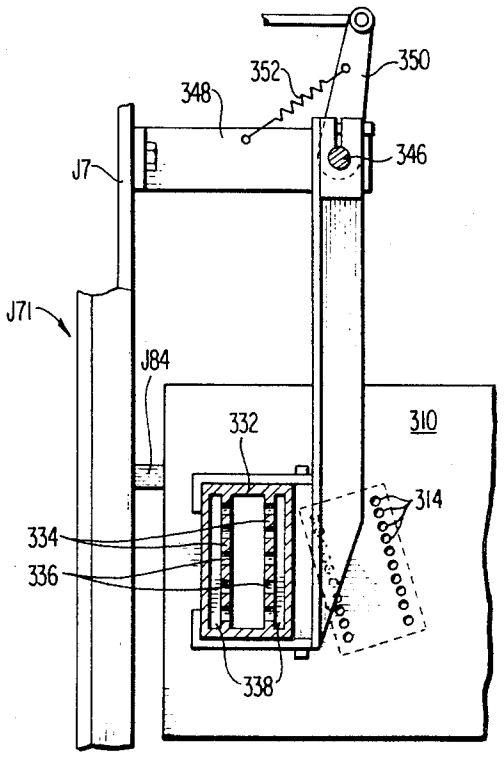


FIG. 16



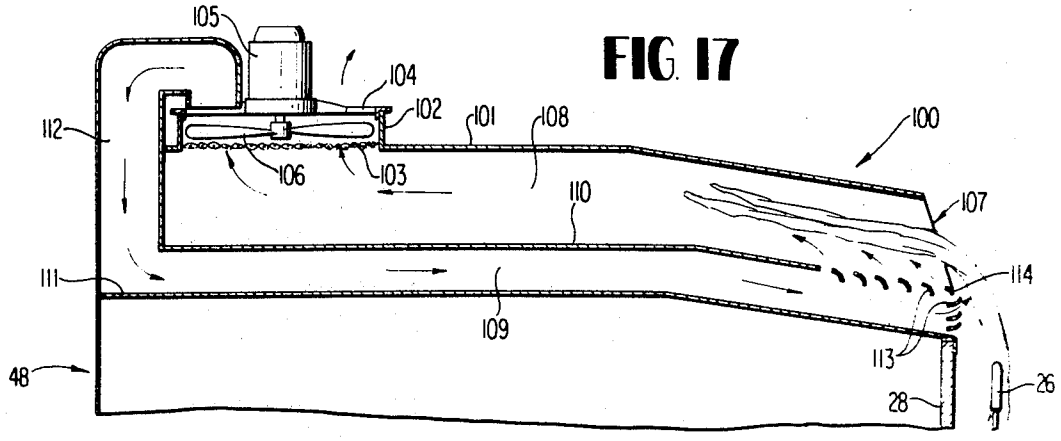
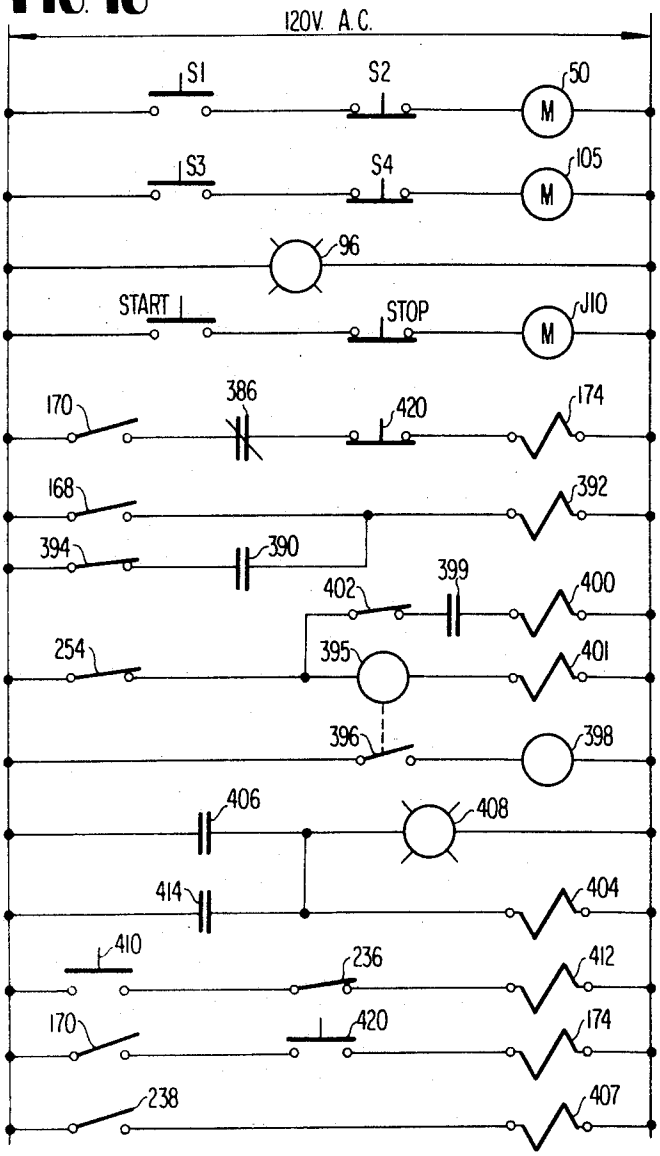


FIG. 17

FIG. 18



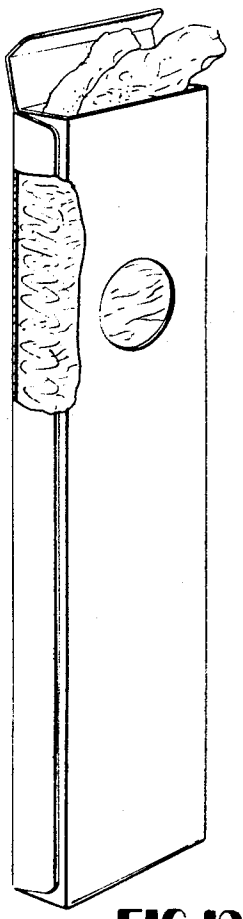


FIG. 19

METHOD OF AND APPARATUS FOR PRODUCING HOSIERY

This invention relates to an improved method for use in the production and processing of hosiery articles, and to improved apparatus for use in carrying out the method. More particularly, the improved method and apparatus are especially useful in the processing of hosiery articles knit from synthetic, stretch yarn. While the invention is particularly well adapted to the processing of garments such as knit leotards, panty hose, tights, or the like, sometimes hereinafter referred to generally as panty hose or panty garments, the invention is not limited to use in the production of such garments but rather may have general application in the production, handling and packaging of various articles. Thus, while the invention will be described herein with specific reference to stockings and panty garments, this reference is for convenience of description of a preferred embodiment only, and it is understood that the invention is not so limited.

The advent in recent years of the super-stretch, synthetic yarns has revolutionized the stocking, or hosiery, industry. Not only has this development made possible the reduction in the number of sizes of stockings produced, or the elimination of sizing entirely by the super-stretch, one-size-fits-all garment, but also have resulted in many changes in the methods and procedures employed in the production, packaging and marketing of the garments. For example, the conventional boarding operation, essential prior to the super-stretch yarns, cannot be employed in the production of stockings knit from these synthetic stretch yarns because the conventional boarding process either destroys or greatly impairs the stretch qualities of the fabric.

The elimination of the boarding operation has greatly complicated the packaging operation since the unboarded garments lack the finished, smooth appearance imparted by the boarding operation so that it is difficult to insert them in a conventional flat package.

The difficulties precipitated by the popularity of the stretch synthetic fibers employed in the production of hosiery were further complicated by the almost simultaneous increase in popularity of panty hose. Thus, the shift was, in effect, from the conventional sized, boarded stocking to the super-stretch, unboarded panty garment. While this shift has produced much speculation of increased automation and the accompanying reduction in cost, workable solutions to the obvious problems have not been readily apparent. For example, while the elimination of the boarding operation was a substantial saving, this saving was largely nullified by the fact that the unboarded garments were difficult to handle and present in a conventional package. Further, substantial difficulty has been encountered in the development of apparatus to automatically package the garments in that the relatively large expanse of shear, delicate, though resilient, fabric was not easily deposited into a container in a manner which was considered to be acceptable to the consumer. Accordingly, it is a primary object of the present invention to provide an improved method and apparatus for use in the semi-automatic production and packaging of hosiery articles.

Another object is to provide an improved method and apparatus for straightening, inspecting, conveying and packaging stretch hosiery articles.

Another object is to provide an improved method of conveying and stacking panty hose.

Another object is to provide an improved method of and apparatus for automatically packaging flexible textile articles.

Another object is to provide an improved method of and apparatus for loading panty hose onto boarding forms, inspecting the panty hose on the boarding forms, and for stripping the hose from the forms.

The foregoing and other objects are attained, in accordance with the present invention, in a system incorporating a semi-boarding apparatus, a stacking apparatus, a packaging apparatus, and a pneumatic conveyor operable to deliver articles from the semi-boarding apparatus selectively to either the packaging apparatus or to the stacking apparatus. The term, "semi-boarding", is employed in this application to denote a process in which hosiery articles, including panty hose, are "boarded", or telescoped onto a boarding form which is designed and dimensioned to expand, or stretch, the article sufficient to straighten and flatten the article and eliminate excess wrinkles, and heat-treating the "boarded" articles on the forms. Preferably the boarding form is a collapsible, open frame structure which is collapsed to facilitate loading the garments onto the form, then expanded to slightly stretch and shape the garment. Once expanded, the open frame form is passed before an illuminated screen or panel which permits a ready and efficient inspection of the garment before it passes into a treatment chamber where sufficient heat is applied to dry the damp garment, and to eliminate wrinkles and substantially set the garment to the smooth, flat shape of the form without relaxing the yarn sufficiently to materially affect its stretch qualities.

Upon leaving the treatment chamber, the collapsible form is automatically collapsed, and the treated garment is automatically stripped from the form by a pneumatic stripper and conveyor which conveys the treated article either to a stacking machine or to an automatic packaging machine. The pneumatic conveying tube has a cross-section which is substantially in the shape of a dumbbell, with the open inlet end of one enlarged portion being positioned directly above the top end of each leg portion of the boarding form when the form is in the stripping position. By stripping the panty hose from the form toes first, with one leg extending into each enlarged channel portion of the conveyor tube, the panty hose continue through the pneumatic conveyor in this manner so that they may be pneumatically stacked in a tray having a central divider, with one leg of the panty garment extending on each side of the central divider.

Alternatively, the treated panty hose may be conveyed directly to an automatic packaging machine where they may be fed directly by the conveyor into the packaging machine or alternatively deposited at a collection station for subsequent manual feeding into the packaging machine. The individual panty hose garments are packaged by initially vacuum-forming the garments in a forming chamber having an internal configuration substantially conforming to the size and

shape of the ultimate package, and subsequently pushing the formed garment into the open end of a carton.

Other objects and advantages of the invention will become apparent from the following detailed description of the invention, taken with the drawings, in which:

FIG. 1 is a plan view schematically illustrating a system for the production of panty hose in accordance with the present invention;

FIG. 2 is an elevational view of the system illustrated in FIG. 1;

FIG. 3 is an enlarged plan view of the semi-boarding apparatus, the pneumatic conveyor, and the automatic stacking apparatus of the present invention;

FIG. 4 is an enlarged view of the collapsible boarding form, in the collapsed condition, employed in the semi-boarding apparatus, and illustrating a portion of the form conveyor and actuating mechanism of the semi-boarding apparatus;

FIG. 5 is a view taken on line 5—5 of FIG. 4;

FIG. 6 is a view taken on line 6—6 of FIG. 4;

FIG. 7 is a view of the collapsible boarding form shown in FIG. 4, with the form illustrated in expanded condition;

FIG. 8 is a plan view, in section, of the semi-boarding apparatus and illustrating the conveyor mechanism for moving the boarding forms about their endless path through the semi-boarding mechanism;

FIG. 9 is a fragmentary sectional view taken on line 9—9 of FIG. 3 and illustrating a portion of the pneumatic stripping and conveyor mechanism;

FIG. 10 is an enlarged view of a portion of a pneumatic conveyor mechanism illustrated in FIG. 3;

FIG. 11 is an end elevational view of an alternate embodiment of the pneumatic stacker;

FIG. 12 is a sectional view taken on line 12—12 of FIG. 11;

FIG. 13 is a sectional view taken on line 13—13 of FIG. 11;

FIG. 14 is an enlarged elevational view, partially in section, of a portion of the automatic packaging apparatus illustrated in FIG. 1;

FIG. 15 is a further enlarged sectional view taken on line 15—15 of FIG. 14;

FIG. 16 is a view similar to FIG. 15, and showing certain components in an alternate position;

FIG. 17 is a sectional view taken on line 16—16 of FIG. 1;

FIG. 18 is a schematic illustration of the system control circuit; and

FIG. 19 is a perspective view of the improved panty hose package of this invention, with a portion broken away and the panty hose partly removed from the carton.

In the manufacture of stretch panty hose from synthetic yarns, it is the conventional practice to knit the garment, either as a unitary structure (except for the elastic waistband) or as separate components which are subsequently sewn together, from undyed yarns and subsequently subjecting the undyed articles to shrinking and dyeing operations. An improved method and apparatus for shrinking and/or dyeing these garments is disclosed and described in copending U.S. Pat. application Ser. No. 847,692, assigned to the assignee of this invention, and the present invention is particularly well adapted for use in combination with the method and apparatus of that application, the present invention being especially useful for further processing of both panty hose and conventional stretch stockings processed in accordance with the teachings of that earlier copending application.

Referring now to the drawings in detail, a shrinking and dyeing apparatus of the general type described in said application Ser. No. 847,692, indicated generally by the reference numeral 10, is illustrated in FIG. 1 as being incorporated in an integrated system for the production of panty hose, with the system including a pair of identical semi-boarding machines 12, each adapted to deliver semi-boarded panty hose to an improved conveyor system 14 for selective delivery either to a stacking apparatus 16 or to an automatic packaging apparatus 18. The dyed shrunk garments, preferably in their damp, extracted condition, are conveyed individually through a pneumatic conveyor system indicated generally by the reference numeral 20 to the loading station of a semi-boarding machine 12. The individual garments 22 are then loaded, with the aid of a vacuum assist loading device 24 on the top of the semi-boarding machine, onto collapsible, open frame boarding forms 26 (see FIG. 3). After the garments are telescoped onto the collapsed frame, the frame is expanded to slightly stretch the garments to flatten the legs and body portion and to remove any wrinkles therefrom. The expanded forms then pass before an illuminated inspection screen to permit the loading operator to inspect the garments through the open-frame form for any defects.

After the panty hose have been inspected on the semi-boarding forms, the forms are conveyed by an endless chain through a conventional treatment chamber where heated air dries the garments and tends to set them in their slightly expanded or stretched condition so that, when removed, the panty hose may be laid flat without excessive effort being required to straighten and remove wrinkles therefrom.

Leaving the treatment chamber and continuing along their endless path, the semi-boarding forms pass a stripping station where the forms are automatically collapsed, as indicated in FIG. 4, to facilitate stripping. At the stripping station, the forms 26 have their upper, toe ends positioned immediately beneath the open end 34 of a dumbbell shaped pneumatic conveyor tube 36, and a flow of air is induced along the toes of the form to lift the toes of the panty hose and convey them into the open end 34 and strip the panty hose from the form.

The legs of the panty hose enter the conveyor tube 36 with one leg extending into each of the enlarged channels of the conveyor tube and with the body portion of the garment extending across the restricted portion of the tube. The flow of air through the pneumatic conveyor tube from the inlet maintains the legs stretched out in their respective channels so that the legs remain separated and substantially smooth as they are conveyed through the pneumatic tube.

The pneumatic panty hose conveyor contains a selector valve assembly 38 for selectively directing panty hose passing therethrough either to the stacking apparatus 16 through conduit 40, or to the packaging machine 18 through conduit 42, and for automatically shifting to direct defective garments to a collection bag 44 through conduit 46.

Referring now specifically to FIGS. 3 through 9, the boarding mechanism for loading panty hose onto the forms, and for inspecting, semi-boarding, and stripping panty hose from the form will be described in detail. The basic boarding machine 12 is of the general type illustrated in greater detail in U.S. Pat. No. 3,054,542, and includes a basic frame and cabinet assembly 48, the structural details of which are not important to the present invention except as specifically described in detail hereinbelow. The lower, base portion of the frame and cabinet assembly 48 serves as a housing for a drive assembly, including a drive motor 50, which, acting through a clutch assembly 52 and belt 54 drives the vertical shaft 56 of a main drive sprocket 58 having spaced notches 60 around its outer periphery for engaging the connector pins 62 of conveyor chain 30. The base portion of the cabinet assembly also houses a conventional blower assembly, not shown, which directs air upwardly over a steam coil assembly, also not shown, and into the treatment chamber 32 to treat panty hose on the forms 26 passing therethrough.

Conveyor chain 30 is constructed of alternating inner and outer links 64, 66 respectively, each made up of a pair of spaced, identical elongated plate members connected adjacent their ends by tubular pin members 68. Preferably, the lowermost plate of the outer line 66 is welded to the lower end of pin 68, and a cylindrical sleeve 70 positioned on pin 68 retains the plates of the inner link 64 in spaced relation. Sleeve 70 is preferably rotatable on pin 62 and acts as a bearing in contact with the drive sprocket 58 and with an idler sprocket 72.

The conveyor chain 30 is driven about an endless path defined in part by a channel shaped guide 74 extending across the front of the semi-boarding apparatus between drive sprocket 58 located at the forward, left hand corner of the frame assembly, as viewed from the front, and the idler sprocket 72 mounted at the right front corner of the assembly by a vertical shaft 76. Similar channel-shaped guides 78, 80 extend rearwardly along the sides of the cabinet assembly from the sprockets 58, 72, respectively into the treatment chamber 32.

The guideway extending through treatment chamber 32 is enlarged to a width substantially equal to the length of the respective chain links 66, 68, and is defined by a pair of horizontal supporting plates 82, 84 positioned beneath and supporting the respective ends of the conveyor chain links when in the folded condition indicated in FIG. 8. Also, a pair of guide plates 86, 88 are positioned to engage the bearing sleeves 70 to fold the chain upon itself and maintain the folded chain in a straight path so that alternate links are positioned in side-by-side relation within the treatment chamber, with alternate pins 62 positioned on opposite sides (front to rear) of the treatment chamber. Conveyor chain 30 has an extended length which is substantially greater than the distance around its endless path through the semi-boarding apparatus so that the excess length of chain will be folded in the treatment chamber as successive links enter the treatment chamber, and unfolded as successive links are pulled from the exit end of the chamber by rotation of the drive sprocket. The links are pushed substantially transversely of their linear dimension through the treatment chamber by successive incoming links in a manner well known in the art and illustrated, for example, by U.S. Pat. No. 2,487,354. Thus, the individual chain links travel at a first uniform speed along the sides and front of the machine, and at a substantially slower uniform speed through the treatment chamber to give the panty hose loaded on forms 26 and carried by the chain sufficient time in the treatment chamber to complete the drying and treating process. The speed of the conveyor along the unfolded portion of its path is governed by the rate at which one or two operators can load and inspect the garments on the forms.

As indicated in FIGS. 3 and 8, the upper portion 49 of the cabinet assembly 48 forward of the treatment chamber 32 is defined by a rear wall 90 and opposed end walls 92, 94 of relatively thin metal material, and a forward wall of substantially translucent, light diffusing material 28. Preferably the inner surface of the metal walls 90, 92 and 94 is coated or polished so as to be light reflective, and a plurality of fluorescent light bars 96 are mounted on wall 90 so that light panel 28 appears as a substantially uniformly illuminated screen which permits the ready inspection of garments supported on the open-frame forms passing closely in front of the screen on conveyor chain 30.

As seen in FIGS. 1 and 3, the vacuum assist loading mechanism 24 is mounted on the top wall 98 of the semi-boarding machine 12. This vacuum assist loading device comprises a relatively thin, flat hollow housing 100 having an annular opening in the top wall 101 thereof near the back of the housing, and a short, annular shroud 102 mounted within the opening and projecting upwardly therefrom. A screen 103 extends over the bottom open end of shroud 102, and a cross-frame 104 is mounted on the top end of the shroud. An electric motor 105 is mounted on frame 104 to drive an exhaust fan 106 to draw air through the open inlet 107. As best seen in FIG. 3, the open inlet 107 extends substantially the full width of light panel 28.

The interior of housing 100 is divided into an upper vacuum chamber 108 and a lower pressure chamber 109 by an intermediate wall 110 mounted between top wall 101 and the top wall 111 of frame 48. An air duct 112 is mounted on the back of housing 100 and has an open inlet extending above and directed downwardly toward the open top of shroud 102 to act as an air scoop in the airstream from fan 106. Duct 112 has its other end connected to chamber 109 to provide a slightly elevated pressure in this chamber. Chamber 109 has a plurality of adjustable louvers 113 adjacent the open inlet 107 of vacuum chamber 108 to provide an escape for the air scooped up and directed into the chamber 109 by duct 112 which tends to lift a garment above the lower edge 114 of inlet 107.

In operation, the exhaust fan 106 will induce a flow of air through the open inlet 107 of vacuum chamber 108 at a sufficient velocity to straighten and draw the legs of a pair of panty hose into the housing 100 when the body portion of the panty garment is held in the vicinity of the top of a collapsible form in front of light panel 28. At the same time, the flow of air out of pressure chamber 109 through louvers 113 will tend to hold the garment out away from the lower edge 114 of the inlet so that the garment is ballooned out slightly at the body section. This ballooning permits the garment to be drawn substantially straight down over the form

without being drawn over the lower edge **114**. Thus, as the panty hose are drawn onto the form, from the top, the legs of the panty hose will be held in an extended position above the top of the form so that the panty hose can be telescoped directly onto the form with a minimum of effort and without excessive or uneven stretching of any portion of the panty hose.

As best seen in FIGS. **4** and **7**, the collapsible panty hose forms **26** include a base **116**, which preferably is in the form of a relatively thin metal bar or plate, having a pair of downwardly extending pins **118** rigidly welded on its bottom edge in position to fit into the open centers of adjacent ones of the tubular pin members **62** of chain **30**. The length of base **116** may be somewhat greater than the length of a single chain link, but is less than the length of two chain links so that a form may be mounted on each successive pair of pins **62** with base **116** remaining parallel to and spaced directly above one outer link **66** of the chain throughout its movement around the endless path through the boarding apparatus. Thus, adjacent base elements **116** on successive forms **26** are disposed in aligned, end-to-end relation as they move in front of inspection screen **28**, and in parallel, side-by-side relation as they move through the treatment chamber **32**.

A first pair of elongated, slender, flat rod, or wire members **120** have their lower end rigidly fixed, as by welding, to the top edge of base **116** and project upwardly therefrom in spaced, generally parallel relation to one another. A short horizontal rod **122** extends between and is rigidly welded to rods **120** at a point above base **116** to strengthen and stiffen the fixed rods **120**.

A first pair of expansion plates **124**, each generally triangular shaped and having rounded corners, are pivotally connected at one of their rounded corners, as by pins **126**, one to the top of each of the rigid bars **120**. A second pair of similar expansion plates **128** each have one rounded corner pivotally connected, as by pins **130** to a second corner of the expansion plates **124**, and also have a second rounded corner pivotally connected, as by pins **132**, one to each of a pair of elongated, slender, flat rod members **134**. A pair of elongated wire members **136** have one end pivotally connected, one to each of the pin members **130** as by a threaded clevis **138**.

Bars **134** extend downwardly from their respective pivotal mounting pins **132** and terminate at their lower end in a forked bracket **140** having one leg extending on each side of base **126** for sliding movement therealong. Movement of the fork **140** is limited in the direction toward rod **120** by the pins **118**, and by the tubular pins **62**, and in the direction away from rod **122** by a fixed pin **142** extending through and projecting outwardly from the sides of base **116**. Vertical downward movement of rod **134** is limited by engagement of the fork with the top edge of base **116**, while upward movement is limited by the expansion plates **124** to **128**. Thus, rods **134** each cooperates with an adjacent rod **120** to define a pair of expansible and collapsible leg forms each dimensioned to receive the leg of a pair of panty hose, and collectively to receive the body of the panty hose garment. The expansion plates **124** and **128** cooperate to close the top end of the leg forms, and to extend upwardly and expand the toe of a garment positioned on the form in the manner illustrated in FIGS. **4** and **7**.

An over-center, spring-biased toggle structure is pivotally mounted on the lower ends of bars **134** to move them between the expanded and collapsed positions. The toggle structure includes a pair of elongated bars **144, 146** having their adjacent ends pivotally connected by a pin **148**, and their opposed ends pivotally connected, as by pins **150**, one to each of the movable rods **134**. A pair of downwardly extending tabs **152, 154**, are formed one on the respective bars **144, 146**, and a coil spring **156** has its opposed ends connected to these tabs **152, 154** to resiliently urge them toward one another. Since spring **156** is disposed to one side of pin **148** when bars **144, 146** are in substantially aligned position as shown in FIG. **7**, the toggle will be retained in this over-center condition until forcibly deflected to position the pin **148** beneath the line of action of spring **156**, at which time the spring will urge the toggle to the collapsed condition shown in FIG. **4**. A tab **158** limits movement of the bars **144, 146** in the upward direction, and a cam **160** is provided to engage a mating cam surface **162** mounted on the frame **48** in position to automatically push the toggle over-center and collapse the form as the form approaches a stripping position following its exit from the treatment chamber. Wires **136** each have their lower ends pivotally connected to one of the toggle bars, in spaced relation to its associated rod **134** to move pin **130** in a vertical direction to collapse and expand the toe of the form, through the pivoted expansion plates **124, 128**, in response to a movement of the over-center toggle arrangement.

From the above, it is seen that the movable rods **134** remain generally parallel, though slightly inclined, with respect to its associated rod **120** to provide a flat, substantially straight, slightly tapered leg form. Such forms are intended primarily to smooth and flatten the panty hose rather than to stretch and set the hose as in a conventional boarding operation.

A reject button **163** is mounted on the leading rod **134** of each form **26**. This reject button is in the form of a headed pin **164** supported for axial movement between an extended and a retracted position through an opening in the bar **134**. Preferably the pin **164** is retained in the retracted or extended position by a detent, not shown, and is manually movable to the reject position to automatically actuate a switch **168**, upon movement of the form through the semi-boarding apparatus, to condition the pneumatic conveyor mechanism to direct a defective garment to a reject collecting bag. A cam **166** mounted on frame **48** automatically returns the reject button to the retracted position before the next garment is positioned on the form.

As the boarding forms leave the treatment chamber and proceed along the portion of the endless path defined by the guide channel **80**, they pass by a stripping station in which the toe portions of the respective legs of each form **26** are positioned directly beneath the open end **34** of dumbbell-shaped vacuum conveyor tube **36** (see FIGS. **3** and **9**). Prior to reaching the stripping station, cam **160** has engaged and been deflected downwardly by cam surface **162** to collapse the boarding form to the condition shown in

FIG. 4, thereby leaving the finished, treated panty hose hanging loosely on the collapsed form. As the form reaches the position shown in FIG. 9, cam 160 engages limit switch 170 which energizes a solenoid valve 174, to direct jets of high pressure air through conduits 176 and upwardly along the toe portion of the forms to strip a pair of panty hose, toes first, from the collapsed form and direct them into the open inlet 34. This high pressure air directed into the conveyor tube 36 will convey the lightweight garments through the tube for a substantial distance without aid of other means to induce the flow of air through the conduit. For longer conveying distances, and to provide a more positive control of the garments during stripping, a vacuum may be applied to the conveyor conduit 36 to assist the air-jet strippers. Alternatively, as described below, the air jets may be eliminated and vacuum alone relied on to strip and convey the garments.

Once the toes of the panty hose are inside the conveyor conduit, the flow of air caused by the jets directed into the tube will continue the stripping action to quickly strip the panty hose from the form even as the form continues its movement along its endless path. This stripping action is very rapid and is normally substantially complete before the legs of the form are moved from beneath their respective channels of the conveyor conduit. As the garment advances into the conveyor conduit, the body portion enters the open end 34 and extends into each of the enlarged channels of the conduit.

As the form leaves the stripping station, reject pin 164 passes cam surface 166 and, if it has been depressed as illustrated in FIG. 5, will be cammed back to the normal position before receiving another garment to avoid the possibility of an operator inadvertently failing to reset the reject button and thereby direct a good garment to the reject bag.

Referring to FIGS. 3 and 10, it is seen that the selector valve assembly 38 employed in pneumatic conveyor system 14 includes an elongated hollow valve element 178 pivotally mounted, as by bracket 180 and a suitable bushing, not shown, on a base plate 182. Valve element 178 has an inlet end 184 substantially larger than conduit 36 and in continuous communication therewith. Valve element 178 also includes an outlet 186 having a size and shape generally corresponding to the size and shape of conduits 40, 42 and 46, and is movable therebetween by a spring 188 and a single-acting fluid motor 190 connected to an arm 192 on bracket 180. As seen in FIG. 10, spring 188 normally urges the valve element 178 upwardly into engagement with a pivoted stop member 194 supported on plate 182 by a pin 196. An arm 198 rigidly connected to pin 196 has one end resiliently urged by spring 200 in a direction to move stop member 194 to a position to limit pivotal movement of valve member 178 to provide fluid communication between conduit 36 and conduit 42. A manually operable selector arm 202 connected to arm 198 is provided to rotate stop 194 to the position shown in FIG. 3 to provide fluid communication between conduits 36 and 40, and a detent 204 is provided to releasably retain the stop member 194 in this second position against the force of spring 200.

Valve element 178 is movable by fluid motor 190 into a position in contact with a second stop member 206 to provide fluid communication between conduits 36 and 46. Fluid under pressure is directed to motor 190 to move valve element 178 into engagement with stop 206, against the force of spring 188, in response to actuation of switch 168 by reject pin 164 to direct a defective garment into reject collecting bag 44.

Referring now to FIGS. 3 and 11–13, it is seen that conveyor conduit 40 leads to the panty hose stacking apparatus 16 which automatically stacks successively delivered panty hose garments in flat, superimposed relation into a stacking tray 208 having a vertical divider partition 210 separating the legs of the garments in the stack. Although trays 208 are illustrated in the drawings as being of open frame construction having open rectangular side walls 212 with a solid bottom panel 214, in practice all internal wall surfaces of the structure are covered by a felt material to avoid damage to the shear fabric of the panty hose. This felt material extends over the tubular frame structure of the side walls and center partition to provide the necessary lateral support for the relatively high stacks during stacking and handling of the trays. Central vertical divider 210 is shorter than the tray so that the panty hose may be stacked within the tray with the crotch portion abutting the end of the divider and the body, or panty portion, being supported on bottom 214 and disposed between side walls 212 as shown in FIG. 1.

The stacking apparatus 16 comprises a vertical frame structure 216 having a vertically movable, horizontal lift platform 218 projecting from one side edge thereof. Platform 218 has a horizontal top surface 220 for supporting and lifting the trays 208 in the stacking position. Platform 218 is mounted for vertical movement by roller guides 222 positioned within a channel 224 of a vertically extending track 226. A hydraulic piston 228, connected to lift 218 through a bracket 230 and connecting rod 232 is movable within cylinder 234 to move the lift along track 226. Switch 236 mounted at the top of track 226 limits upward movement of the platform 218. Switch 238 is mounted on the lower portion of track 226 in position to be engaged by the lift in its fully lowered position and conditions the control circuitry to discharge a filled tray and to feed an empty tray into the stacking position on platform 218.

The conveyor conduit 40 has its outlet end connected to the open end of a similarly shaped, vertically extending stacking conduit 240 within the stacking machines 16. Conduit 240 is supported for pivotal movement about a horizontal axis adjacent its upper end by a support arm 242 and pivot shaft 244 extending through a rigid bracket 246 on frame 216. An elongated connecting rod 248 has one end pivotally connected to the end of support arm 242 and its other end pivotally connected to an eccentric pin 250 on a single revolution clutch drive mechanism 252. Upon energization, the single revolution clutch is operable, through the connecting rod 248, to oscillate support arm 242 about the horizontal pivot shaft 244 to move the stacking arm through one complete cycle only from the full line to the phantom line and back to the full line position shown in FIG. 3. Stacking hose 240 terminates at its lower end in a horizontal ell portion having an open outlet 256 normally positioned adjacent one vertical end of the vertical partition 210 of a tray 208 when the tray is positioned on the movable platform

218. A switch 254 is mounted on the outlet end 256 of stacking conduit 240 to sense the delivery of a garment through the conduit and to energize the drive clutch 252 to pivot the conduit 240 from the full line delivery position to the phantom line retracted position shown in FIG. 3, and to control the downward movement of piston 228 to lower platform 218 a predetermined amount after delivery of each garment to thereby maintain the top surface of a stack of garments in the tray 208 at substantially the same level just below the outlet 256. Conduit 240, as well as conduits 36, 40, 42 and 46 are preferably formed from a pair of similar, separately formed, substantially W-shaped half sections secured together to form the dumbbell shaped conduits as seen in FIGS. 9-11.

Although the flow of air through the conduits 40 and 240, combined with the inertia of the garment moving through the conduits, may be sufficient to straighten the legs of a garment issuing from outlet 256, it may be desirable to assist in this straightening operation. To accomplish this, in the embodiment illustrated in FIG. 3, a pair of tubes 258 have their open outlets positioned adjacent outlet 256, and jets of air, under pressure, issuing from these open outlets will assist in straightening the legs. Flow of air through the pipes 258 is controlled by the switch 254 so that air is issued from the tubes only for a short time as a stocking is being delivered. Since the end of the vertical partition 210 is positioned adjacent the restricted center portion 260 of the outlet 256, with the enlarged channel portions 262, 264 disposed one on each side of the vertical position, the panty hose legs will extend one on each side of the vertical partition, with the crotch portion of the body resting against the end of the partition. By interrupting the flow of air through the conduits 40 and 240 prior to pivoting the stacking conduit 240 to the retracted position, the body portion will automatically be straightened to lie flat as the body portion is drawn from the outlet 256 by the retraction of the stacking conduit.

Referring now to FIGS. 11 and 13, an alternate embodiment of the stacking apparatus will be described wherein vacuum is applied to the conveyor conduit 40 through the open end 256 of the stacker conduit 240 to assist in stripping the garments from the boarding forms and conveying the garments through the conveyor system to the stacking position, as well as to straighten the legs of the panty hose in the trays. To accomplish this, a frame structure 266 supports a pair of parallel, horizontal conduits positioned one on either side of the vertical partition 110 of tray 108 and spaced above the bottom thereof when movable platform 218 is in its fully elevated position. The conduits 268 have their open ends positioned one adjacent the enlarged channel portions of outlet 256, and have their opposite ends connected, within frame 266, to the inlet of an exhaust blower 270 through a conduit 272. A quick-acting solenoid valve 274 controls the flow of air through conduit 272 to thereby control the application of vacuum through conveyor conduits 40 and 240 to strip the garments from the form and convey the garments through the conduits to the stacking trays.

As shown in FIG. 13, conduits 268 are each in the form of an inverted U-shaped channel 276 with a hinged trap door 278 mounted on the outer, lower edge of the channel to define the bottom wall of the conduit. The trap doors 278 are moved between the closed, full line position shown in FIG. 13 and the open, broken line position by two-way fluid cylinder 280 acting through a bracket 282, connecting rods 284, and levers 286. The trap doors 278 are normally retained in the closed position so that vacuum applied within the conduits 268 will induce a flow of air through stacker conduit 240 and conveyor conduit 40. When a pair of panty hose are discharged from the exit 256 of stacking conduit 240, the legs of the garment will be extended into the conduits 268 until an electrical signal from switch 254, acting through a time delay relay 273, closes valve 274 and simultaneously actuates cylinder 280 to open trap doors 278 to permit the legs of the panty hose to drop to the stack in the tray. At the same time, stacker conduit 240 is pivoted to the retracted position to withdraw the body portion of the panty hose from the outlet 256 to permit the body portion to drop onto the stack.

Since the vacuum applied by the blower 270 will normally be sufficient to induce a flow of air at the inlet 34 of conduit 36 sufficient to strip the panty hose from the forms 26, the air conduits 176 may be omitted from this embodiment, if desired.

As illustrated in FIG. 12, a driven conveyor 288 is employed to feed the stacking trays 208 onto the top surface 220 of lift 218, and a second driven conveyor 290 is employed to convey the filled trays from the stacking apparatus. Conveyor 288 comprises a frame 292 having a substantially flat, smooth top surface 294 through which feed fingers 296 project to engage successive trays to move them along surface 294. Feed fingers 296 are mounted on an endless chain supported by sprockets 298, 300 beneath surface 294. A motor 302, acting through a single revolution clutch 304, drives sprocket 300 to advance the chain to feed an empty tray onto the lift 218, and simultaneously to push a filled tray on the lift onto conveyor 290. Clutch 304 is energized to drive conveyor 288 through a distance equal to the spacing between successive fingers 290.

Referring now to FIGS. 1, 2 and 14–16, the automatic packaging apparatus of this system will be described in detail. As indicated hereinabove, the packaging apparatus is of the type in which collapsed cartons, fed one at a time from a magazine, are erected and transported past a filling station and a flap-folding mechanism before being discharged from the apparatus. While the invention may be incorporated into various continuous and intermittent operation cartoning machines, it is particularly well adapted for use with the intermittent motion cartoning machine illustrated and described in U.S. Pat. No. 3,258,893 to Jones, the disclosure of which is incorporated herein by reference. The primary improvement in this cartoning machine over that of the Jones patent is in an improved apparatus for automatically filling the open cartons, and will normally be mounted on the machine frame in the vicinity of, or replace, the leaflet folding and feeding mechanism of the Jones patent.

In the description of this portion of the invention, reference numerals preceded by the letter J refer to structure illustrated in the Jones patent and having corresponding reference numerals. Thus, it is seen that cartons C are moved along a fixed path past the filling

mechanism by the U-shaped limbs J84 of conveyor lugs J24 carried by upper and lower conveyor chains J22 and J23, respectively. Chains J22 and J23 are confined within a guide rail J71 defined by a flat bar J72 and a pair of opposed structural angles J74. The cartons C have their closed bottom end supported on a slider plate J50, and are supported laterally by retainer rails J47 and J55.

The carton filling mechanism is supported on horizontal frame rails J6 and J7 and extends laterally from one side of the machine frame at a position spaced downstream from the empty carton magazine distance sufficient to permit the carton flap folders to fold the bottom flaps to the closed position before reaching the filling station. A first horizontal plate 310 is rigidly mounted in vertically spaced relation to slider plate J50 and has a rectangular opening 312 therein in position to overlie and substantially conform to the rectangular top opening in a carton C at the filling station as illustrated in FIG. 14. A plurality of small apertures 314 are formed in plate 310 and arranged in two parallel rows laterally spaced from and disposed at an angle with respect to rectangular opening 312. A conduit 316 has one end mounted on the bottom surface of plate 310, as by rectangular flange 318 overlying the plurality of apertures 314, to provide fluid communication through plate 310 into conduit 316. The conduit 316 has its other end connected to a source of vacuum, not shown, to induce a flow of air downwardly through the apertures 314 into conduit 316. The two rows of apertures are spaced apart a distance slightly greater than the transverse dimension, or thickness, of the carton C for reasons which will be explained herein below.

A second horizontally disposed plate 320 is mounted in vertically spaced, parallel relation above plate 310, and is rigidly supported by a vertical standard 322 mounted on and projecting upwardly from rail J6. A pair of apertures 324, 326 are formed in plate 320, with aperture 324 being vertically aligned above rectangular opening 312. Aperture 326 is rectangular in shape and substantially the size of the cross-sectional dimensions of the carton C, and is positioned in alignment with and spaced vertically above the portion of plate 310 between the two rows of apertures 314.

An elongated vacuum forming chamber assembly 328 extends between plates 310 and 320, and is mounted for movement between the full line forming position and the phantom line packaging position shown in FIG. 14. Forming chamber 328 has an open top end in sliding contact with the bottom surface of plate 320, and an open bottom end in sliding contact with the top surface of plate 310. As best seen in FIGS. 15 and 16, forming chamber 328 is made up of opposed, parallel side walls 330 and opposed parallel edge walls 332 joined along contiguous edges to define a rigid, fluid-tight chamber. A pair of opposed, parallel intermediate walls 334 are mounted within the chamber and extend between edge walls 332 in spaced relation to side walls 330. Intermediate walls 334 have a relatively large number of small apertures 336 formed therein and spaced substantially over their entire surface.

As seen in FIG. 15, the intermediate walls 334 and the associated side walls 330 cooperate to define a thin channel 338 overlying the two rows of small apertures 314 when the forming chamber is in the forming position. Also, intermediate walls 334 and opposed end walls 332 cooperate to define an elongated rectangular forming chamber 340 having internal dimensions substantially conforming to the internal configuration and size of the carton C. The open top end of this central forming chamber 340 is aligned with and underlies the aperture 326 in the top plate 320 when the vacuum forming assembly is in the forming position, with the bottom open end of the central forming chamber 340 being closed by the portion of the bottom plate 310 which is disposed between the two rows of apertures 314. In this position, apertures 314 provide fluid communication between vacuum conduit 316 and channels 338 to apply vacuum to forming chamber 340 through apertures 336. In the packaging position of the vacuum forming assembly, illustrated in FIG. 16 and in the phantom line position of FIG. 14, the open top of central forming chamber 340 is in vertical alignment with aperture 324 in plate 320, and the bottom open end of the forming chamber is disposed above and in alignment with aperture 312 in plate 310.

To support the vacuum forming assembly for reciprocating movement between the forming and packaging positions, the forming assembly 328 is mounted by a bracket assembly 342 on the end of a horizontally extending support arm 344 which, in turn, is rigidly clamped on a vertically extending shaft 346. A rigid bracket 348 mounted on rail J7 supports vertical shaft 346, in suitable bearings (not shown) for rotation about its longitudinal, vertical axis. A laterally extending arm 350 supported on shaft 346 is resiliently urged by spring 352 in a direction to move the vacuum forming assembly to the forming position. To move the support arm 344 and the vacuum forming assembly to the packaging position, a bell crank assembly 354 has one end connected to arm 350, and has a roller cam follower 356 engaging an eccentric cam 358 rotatably mounted on shaft J18. Since shaft J18 is driven intermittently, in specific timed relation to the feeding of cartons along slider plate J50 past the filling station, the position of eccentric cam 358 will serve to coordinate movement of the forming assembly with advancement of the individual cartons C through the apparatus so that the forming chamber is positioned above the opening 312 in plate 310 each time that a carton C is positioned beneath this opening.

To propel a vacuum-formed article from the central forming chamber 340, a quick-acting, two-way fluid cylinder 360 is supported, as by arms 362 mounted on vertical standard 322, with the piston 364 in the retracted position disposed directly above and in alignment with apertures 324 and 312. Application of fluid under pressure to cylinder 360 through conduit 366 projects piston 364 so that the enlarged head 368, which is preferably cylindrical and somewhat smaller than the minimum dimension of the open top of carton C, downwardly through aperture 324 and 312 to push a formed article from the chamber 340 when the vacuum forming assembly is in the packaging position. Upon completion of the downward stroke, fluid, under pressure, is admitted to cylinder 360 through conduit 370 to quickly return piston 364 to the retracted position.

To prevent damage to the apparatus in the event of the piston 364 drifting downward before the vacuum

forming assembly **328** reaches the packaging position, a metal plate **370** mounted on the end of a piston **372** of a second fluid motor **374** is normally projected over the top of aperture **324** beneath enlarged head **368**. This plate **370** must be fully retracted by the application of fluid pressure through conduit **376** before piston **364** can start its downward movement.

As seen in FIG. **14**, panty hose may be fed to the packaging machine automatically through the conduit **378** directly from the semi-boarding machine. Vacuum necessary to convey the panty hose from the semi-boarding machine **12** is applied through the conduit **316** through the aperture **314** in plate **310** and the vacuum forming assembly **328** to the conduit **378** through aperture **326** in plate **320**. As the individual panty hose garments arrive at the packaging apparatus, they will be drawn into the vacuum chamber **340** and dispersed substantially uniformly throughout the chamber due to the plurality of apertures **336** disposed substantially over the entire surface of the intermediate walls **334**. Thus, the panty hose garments are vacuum formed into a configuration substantially conforming to the interior dimension of the carton into which they are ultimately packed. Further, since the panty hose garments are drawn, toes first, from the forms and conveyed directly to the packaging apparatus, it has been found that, by using a relatively long, thin central forming chamber **340**, the garment will be formed in the chamber with the toes together at one end of the chamber and the open body at the opposite end of the chamber, and with the intermediate portion essentially accordion-folded back and forth across the narrow dimension of the vacuum chamber between opposed perforated side walls. This configuration is retained when the vacuum-formed panty hose are telescoped from the vacuum forming chamber into the carton so that the packaged garment may be drawn from the package toes first, as illustrated in FIG. **19**, to be completely extended when removed, thereby eliminating any unfolding or other straightening. This package configuration is reliably obtained when packaging sheer stretch panty hose into a carton (and a corresponding forming chamber) having internal dimensions of approximately ¾ inch × 2 ¼ inches × 9 inches. The same package configuration may be obtained for a pair of sheer stockings using a shorter carton of substantially the same cross-section.

By packaging panty hose and stockings loosely to substantially fill the entire carton in the manner described above, there is no tendency for the garments to be withdrawn from the carton in a crumpled mass to thereby present an unsightly first appearance to the purchaser or consumer of the garments. This feature is particularly important for sheer garments which present a materially better and more pleasing appearance when in the extended condition. Also, the loosely formed garment in the package permits a more reliable determination of fabric color or shade through a transparent viewing window W in the wall of the carton C, thereby greatly reducing the tendency of shoppers to open the cartons to check the color of the garment.

While the apparatus is particularly well adapted to form packages of the configuration illustrated in FIG. **19**, it is not so limited and may readily be employed to form packages of various configurations. For example, the articles to be packaged may be delivered in random orientation to the forming apparatus where one or a plurality of the articles are formed and packaged into any suitable container. Thus, while the forming chamber **340** has been described as having a size and configuration generally conforming to that of the carton C, the only practical limitations are that the effective volume of the forming chambers should not be substantially larger than that of the container, nor should the open end of the forming chamber be larger than the opening into the cartons through which the formed articles are transferred. Where it is not considered advantageous to maintain the specific configuration of the packaged articles as formed in the forming chamber, the articles may be formed into a relatively tightly compacted mass and transferred into a container of any desired size and configuration, then, if desired, permitted to expand to fill the container.

The packaging apparatus may also be employed to package panty garments, stockings, other flexible textile or similarly flexible articles fed manually to the device. As shown in FIG. **14**, a horizontal table **380** is provided to support a supply of articles to be packaged. A conveyor tube **382** has its inlet end connected to an aperture **384** in table **380** and its discharge end connected to the top surface of plate **320** above the aperture **326**. Garments to be packaged are then fed individually to the aperture **384** and, when the vacuum forming assembly is in the forming position, vacuum will be applied through the conduit **316** and the vacuum forming assembly **328** to apply a suction within conveyor conduit **382** to draw the individual articles through the conduit and into the forming chamber **340**. Operation of the packaging assembly per se is identical to that described above for the automatic operation in combination with the semi-boarding machine. Since there is no vacuum in conveyor tube **382** when the vacuum forming assembly is in the packaging position, the apparatus automatically acts as its own pacer, eliminating any tendency to overfeed the device. Also, if found necessary, a suitable sensing device such as a photo-electric cell may be employed to temporarily interrupt operation of the cartoning machine or to reject the empty package in the event of failure to deliver an article to be packaged. This sensing device may be particularly important for the manual-feed operation of the device.

As indicated in FIGS. **1** and **2**, the cartoning apparatus may readily be employed to package panty hose from two semi-boarding machines **12** operating simultaneously as the cartoning apparatus is capable of operation at a substantially greater rate than one, or even two operators can normally semi-board and properly inspect panty garments on the collapsible boarding forms of a single boarding machine. When the cartoning apparatus **18** is employed with two semi-boarding machines, the vacuum conveyor conduits **378**, connected to the conduits **42** from the respective semi-boarding machines, are each connected to the inlet side of a selector valve assembly **386** which, in turn, has its single outlet connected to the top surface of plate **320**. Selector valve assembly **386** is of the type commercially available and commonly used in pneumatic conveying systems in the hosiery industry and

will not be described in detail here. However, it should be pointed out that the valve assembly functions to prevent garments received from two different sources substantially simultaneously from passing through the valve together. Instead, the first-to-arrive garment is permitted to pass on through the assembly uninterrupted while the second-to-arrive garment is blocked from passage for a predetermined time.

In describing the overall operation of the system, particularly with regard to the semi-boarding, conveying, and stacking features, reference will be made to the electrical schematic diagram contained in FIG. **18**. Referring first to the operation of the semi-boarding apparatus **12**, drive motor **50** is energized by manually closing the normally open contacts of switch **S1**, and motor **50** continues to operate to drive conveyor chain **30**, with the collapsible boarding forms **26** supported thereon, about its endless path until the normally closed contacts of stop switch **S2** are manually opened. Similarly, fan motor **105** is controlled by manually controlled start switch **S3** and stop switch **S4**. The fluorescent lamps **96** are continuously lit when the circuit is energized so that the inspection screen, or panel **28** is continuously illuminated.

The panty hose garments **22** are received at the loading station at the front of the semi-boarding machine where they are manually loaded on the forms **26** moving across the front of the machine on chain **30** in front of inspection screen **28**. The garments may be delivered individually as through pneumatic conveyor **20** from the shrinking and dyeing apparatus **10**, or in groups in bags or stacks from prior operations. An operator, standing in front of the loading station, picks up a pair of panty hose and, holding onto the elastic waistband at the top, flips the garment up in front of the inlet **107** of the vacuum assist loading device. The flow of air into the opening **107** will quickly draw the legs of the damp garment into the vacuum chamber **108** to straighten the garment out from the operator's hand.

Using both hands to grasp the waistband, one at opposite sides thereof, the operator positions the open top of the garment over the toe portion of the form **26** and commences to draw the garment downward to telescope it onto the form. Pressure air flowing out of chamber **109** through louvers **113** balloons the garment up and out from the lower edge **114** of entrance **107** and tends to keep the portion of the garment which extends into chamber **108** suspended in the airstream flowing through the chamber. This not only reduces the force required by the operator to draw the damp garment from the vacuum chamber, but more importantly tends to direct the garment straight down onto the top of the form, thereby eliminating the normal uneven stretching of the garment as it is drawn onto the form.

With the panty hose drawn fully down on the collapsed forms **26** so that the toes of the garment engage the expansion plates **124**, **128**, the operator grasps the two rods **134** at a point below the garment and pulls the rods away from one another to slightly stretch the garment and move the toggle structure to its overcenter position to retain the form in the expanded condition. This movement pivots the expansion plates up and out to expand and form the toe portions of the garment.

Since the plane of the forms **26**, when moving along the front of the machine, is parallel to and spaced closely in front of the illuminated inspection screen **28**, the loading operator can readily and quickly visually inspect the boarded garments for defects, through the open-frame form, as soon as the form is expanded. If the garment is found to be free of defects, no action is required by the operator. If a defect is detected, the operator simply depresses the reject button **163** and the treated garment will automatically be directed to the reject collecting bag **44** as described herein below. Since the operator does not have to remove the defective garment from the form before it passes into the treatment chamber **32**, a more reliable inspection is normally achieved.

As can be seen from FIG. **3**, the inspection screen is of sufficient width to permit two operators to load and inspect panty hose on the apparatus. This feature, in combination with the vacuum assist loading, permits the semi-boarding apparatus to be operated at a very high rate.

In the embodiment of the semi-boarding apparatus shown in FIGS. **3** through **9**, limit switch **170** is mounted on frame **48** in position to be engaged and have its normally open contacts closed by successive boarding forms **26** moving into the stripping position. Closing switch **170** energizes solenoid valve **174**, through the normally closed contacts of relay **386** to direct air under pressure from the conduits **176** to thereby direct a flow of air along the form **26** at the stripping position to strip a pair of panty hose from the collapsible form. Before reaching the stripping position, cam **160** has, of course, been deflected downward by cam surface **162** to collapse the form **126**. Also, if reject button **162** has been manually actuated to indicate that the panty hose on the form are defective, the protruding pin **164** will have engaged and momentarily closed the normally open contacts of reject switch **168** thereby closing the normally open contacts of holding relay **390** to energize solenoid valve **392** to direct fluid under pressure to the fluid motor **190**. Actuation of fluid motor **190** pivots valve member **178** into contact with stop **206** to direct the defective panty hose through conduit **46** to reject bag **44**. The panty hose issuing from the conduit **46** engages and momentarily opens the contacts of normally closed limit switch **394**to thereby open the contacts of holding relay **390**, de-energizing solenoid valve **392** and thereby permitting the valve element **178** to be returned by spring **198** to its preselected position as determined by the position of movable stop **194**. As the collapsed boarding form moves beyond the stripping position the reject pin **164** engages cam surface **166** and is automatically cammed back to its normal position.

Assuming now that the selector valve assembly **38** is positioned to direct garments into conveyor conduit **40**, and that the reject button has not been depressed as described above, the panty hose garments stripped from the collapsed loading form will be transported through the dumbbell-shaped conduits **40** and **240** and discharged therefrom, toes first, with the legs distending one on each side of the vertical partition **210** in tray **208**. Issuance of the toes of the panty garments from outlet **256** actuates a limit switch **254** (illustrated in FIG. **3** as lever-actuated, though preferably photocell-actuated) to energize the coil **395** of a 12-step, rotary "dozen counter" switch **396** which, upon each

complete revolution, closes a first set of normally open contacts in a conventional dozen counter **398** to register the stacking of successive dozens of panty hose. Simultaneously, switch **254** closes the normally open contacts of relay **399** to momentarily energize solenoid actuated valve **400** to direct a jet of air from the conduits **258** to assist in distending and straightening the legs of the panty hose issuing from the outlet **256**.

Closing switch **254** also energizes solenoid **401** to engage the single revolution clutch **252** to pivot the stacking conduit **240** about the horizontal pin **244**. Initial movement of support arm **242** engages the actuator arm of limit switch **402** to open its normally closed contacts, thereby de-energizing solenoid valve **400** so that air is permitted to escape from conduits **254** only for a sufficient time to assist in carrying the legs of the stockings to fully distend them along the stack in tray **208**. Further pivotal movement of the stacking conduit **240** will drag the body portion of the panty hose from the exit **256** and permit them to drop in a flat condition on top of the stack. As the garment passes from the open end **256** of the stacker conduit **240**, the photocell actuated switch **254** is again opened. Switch **402** is returned to its normally closed condition by return of the stacker tube **244** to its normal position.

The dozen counter **398** may be preset to stack any predetermined number of dozens of panty hose in the trays **208**. For normal weights of material, approximately 15 dozen pairs of panty hose may be stacked in the individual trays and, upon delivery of this number, a second set of normally open contacts **406** in dozen counter **398** are closed, energizing solenoid actuated valve **404** to move lift **218** to its fully lowered position, and at the same time to energize a signal light **208** to provide a visual signal indicating the completion of a full tray. Lowering of lift **218** actuates limit switch **238** which energizes solenoid **407** to engage single revolution clutch **304** of conveyor **288** to advance an empty tray **208** onto lift **218** and to discharge the filled tray onto the conveyor **290**.

When the dozen counter reaches the preset number, the normally closed contacts of relay **386** are also opened to thereby disable the stripping mechanism by de-energizing solenoid valve **174**. Thus, it is not necessary to shut down the semi-boarding apparatus during the temporary interruption of the stacking operation required to replace the filled tray with an empty one. Instead, the previously treated panty hose are merely returned to the leading station where the operator again expands the collapsible form and, if the stocking is defective, again sets the reject button and permits the previously treated garment to make a second pass through the treatment chamber.

With the new, empty tray in place on lift **218**, the operator manually actuates switch **410** to energize solenoid actuated valve **412**, through the normally closed contacts of safety switch **236**, to raise the lift to the fully elevated position where the lift actuates switch **236** to de-energize the solenoid valve **412**. The operator then resets the dozen counter **398** to condition the apparatus to resume the stacking operation. It is to be understood, of course, that the elevation of the lift, and the resetting of the dozen counter could readily be fully automated, completely eliminating the necessity for any attention by an operator.

In order for the legs of panty hose being stacked in the tray to be fully distended from outlet **256** without interference from the top of the stack, it is necessary for the top of the stack to be maintained at a level below the outlet **256**. At the same time, if the legs of the garment are permitted to fall too far while the body is still in the end of the stacking tube **240**, the garments tend to bunch and not lay flat when the body falls. In order to maintain the lift **218** at an elevation which will maintain the top of a stack in the tray **208** at the desired level, suitable means such as a set of normally open contacts **414** in switch **396** may be employed in the circuit to solenoid actuated valve **404** to lower the lift a predetermined small amount after each successive garment has been stacked. Alternatively, a photoelectric sensor connected in the circuit to solenoid valve **404** may be employed to sense the top of the stack and actuate the valve to maintain the lift at the proper elevation.

The embodiment of the stacking apparatus illustrated in FIGS. **11–13** is essentially the same as that described above, with the exception that stripper switch **388** is employed to actuate solenoid valve **274** to apply vacuum, through conduits **268** and **272**, to the conveyor system to strip the panty hose from the forms **26**, either with or without the assistance of the pressurized air from valve **174** and conduits **176**. Also, in this embodiment the jets of pressure air from conduits **258** are not employed, and solenoid actuated valve **400** is employed to direct fluid under pressure to fluid cylinder **280** to actuate the trap doors **278**.

When the selector switch **38** is positioned to direct the treated panty hose through conduits **42** and **378** to the packaging machine **18**, the above-described circuitry for the stacking apparatus has no effect on operation of the system except for the necessity of providing an override circuit to permit operation of the solenoid actuated valve **174** when the stacking apparatus is not in operation, and when pressure air is employed either alone or to assist the vacuum in conveyor conduit **36** in stripping the garment from the form. This is accomplished by providing a two-way selector switch **420** having a first set of normally closed contacts connected in the circuit between relay **386** and solenoid actuated valve **174**, and a second set of normally opened contacts connected in a second circuit between stripper switch **170** and valve **174**. Thus, when the system is being employed to stack garments, the start switch is manually actuated to energize the variable speed power unit **J10**, and switch **420** is manually positioned to complete the circuit between relay **386** and valve **174** and to interrupt the circuit between stripper switch **170** and valve **174**. To condition the circuit for packaging, switch **420** is merely reversed and, if desired, provisions may be made for completely de-energizing the portion of the circuit leading to the stacking apparatus.

When vacuum alone is employed to strip the panty hose and convey them to the packaging machine, it is desirable to provide a valve operable in response to stripper switch **170** to apply vacuum at conveyor inlet **34** only when a form is in the stripping position.

While I have disclosed preferred embodiments of my invention, it should be apparent that many modifications therein may readily be made. For example, while

the packaging machine has been specifically described as an intermittent motion apparatus, employing only a single vacuum forming chamber, it should be apparent that this basic principle could readily be employed on a continuous motion packaging machine, employing a plurality of vacuum forming chambers movable along the path of the moving, open cartons. Also, a plurality of vacuum forming chambers could readily be employed, as on a turret structure, in an intermittent motion cartoning machine to greatly increase the speed of operation of the device. It is also contemplated that the forming chamber may be mounted in a fixed position with a discharge outlet adjacent the open end of a carton at the filling station, and with a movable wall closing the discharge outlet during the forming operation. In the case of the fixed forming chamber, the pneumatic conveyor may discharge the garments directly into the forming chamber as through an inclined chute connected to an opening in an extended side wall of the forming chamber. Further, while the packaging apparatus has been described as being particularly useful in the packaging of panty hose or the like, it should be apparent that the apparatus could be employed to package any textile or other pliable article capable of being shaped in the forming chamber.

It should also be readily apparent that the various components of the system may have separate utility. For example, panty hose, leotards, or the like dried in a conventional tumble dryer could readily be fed through the conveyor system of the present invention to be stacked in superimposed flat laying condition by the stacker **16** or to be packaged by the packaging apparatus **18**. Thus, while I have disclosed and described preferred embodiments of my invention, I wish it understood that I do not intend to be restricted solely thereto, but that I do intend to include all embodiments thereof which would be apparent to one skilled in the art and which come within the spirit and scope of my invention.

I claim:

1. A panty hose processing and handling system comprising, in combination, semi-boarding means for semi-boarding individual panty hose garments, stacking means for stacking panty hose garments in a flat stack with the legs of the garments extending in side-by-side relation, packaging means for packaging individual, semi-boarded panty hose garments into cartons, and garment conveyor means for conveying semi-boarded panty hose garments from said semi-boarding means and selectively delivering the conveyed garments to said stacking means or to said packaging means, said semi-boarding means including a plurality of collapsible boarding forms, a form conveyor for moving the forms about an endless path past a loading station through a treatment chamber and past a stripping station, and means for collapsing the boarding forms at said stripping station, said garment conveyor means including stripper means.

2. The processing and handling system defined in claim **1** wherein said garment conveyor means is a pneumatic conveyor and comprises a conduit having a substantially dumbbell-shaped passage extending therethrough with the enlarged portions of said passage each adapted to receive one leg of a garment stripped from said collapsed forms and maintain said legs separated during passage of the garment through the conduit to facilitate stacking, and means creating a flow of air along the top portion of said forms into and through said conduit when said forms are at said stripping station to pneumatically strip the garments and deliver them toes first into said conduit.

3. The processing and handling system defined in claim **2** wherein said packaging apparatus comprises vacuum forming means for receiving garments from said pneumatic conveyor means and forming the garments into the general configuration of a carton, and means for transferring the formed garment into an open carton.

4. The processing and handling system defined in claim **3** wherein said stacking means comprises vertically extending stop means extending adjacent the constricted portion of said conveyor conduit at the outlet thereof in position to engage and arrest the crotch portion of a panty garment discharged therefrom while permitting the legs thereof to pass one on each side of said stop, and means for interrupting the flow of air through said conduit to permit an arrested article to fall free from said outlet.

5. In a cartoning system in which a plurality of open cartons are conveyed seriatim past a filling station for receiving individual articles deposited therein, the improvement comprising the steps of vacuum forming successive individual flexible textile articles into a forming chamber and transferring the formed articles from said chamber into said cartons at said filling station.

6. In the art of conveying open containers past a filling station, depositing articles into the individual containers at the filling station, and subsequently closing the containers, the improvement comprising the steps of delivering pliable articles to the filling station, inserting the individual articles into a forming chamber by use of pneumatic pressure differential, and transferring the formed articles from the forming chamber to an open container at the filling station.

7. The method defined in claim **6** wherein said step of delivering said articles to said filling station includes conveying the articles through a pneumatic conveyor conduit.

8. The method defined in claim **6** wherein the step of inserting said articles into said forming chamber comprises applying a vacuum within said forming chamber to draw the articles into the chamber.

9. The method defined in claim **8** wherein the step of applying said vacuum comprises withdrawing the air from within said chamber through a plurality of spaced apertures formed in at least two opposed side walls of said chamber.

10. The method defined in claim **9** wherein said at least two walls extend in the direction of movement of the articles into said chamber.

11. The method defined in claim **10** wherein said step of delivering said articles to said filling station includes conveying the articles through a pneumatic conveyor tube.

12. The method defined in claim **7** wherein said step of inserting said articles into said forming chamber comprises applying a vacuum within said forming chamber to draw the articles from said pneumatic conveying tube into said chamber.

13. The method defined in claim 12 wherein the step of applying said vacuum comprises the steps of withdrawing air from said chamber through a plurality of spaced apertures formed in at least two opposed walls of said chamber, said at least two walls extending in the direction of movement of the articles into the chamber.

14. The method defined in claim 9 wherein said step of inserting said articles into said forming chamber includes applying a vacuum within said forming chamber to draw the articles from said conduit into said forming chamber.

15. The method of packaging panty garments into elongated cartons comprising the steps of conveying successive garments through a pneumatic conveyor conduit to a forming station, inserting the individual garments into a forming chamber by use of pneumatic pressure differential to shape the garments into the configuration of said forming chamber and substantially corresponding to the internal configuration of said elongated cartons, and transferring the formed garments into said elongated cartons.

16. The method defined in claim 15 further comprising the steps of advancing successive elongated cartons seriatim past a filling station adjacent said forming station with one end of said cartons being held open to receive the formed garments, and subsequently closing the open end of the cartons to complete the packaging operation.

17. The method defined in claim 15 wherein said panty garments are conveyed toes first through said pneumatic conveyor conduit with the legs thereof in side-by-side relation, forming said garments into the elongated forming chambers with said toes at one end thereof and with the top of the garment at the other end thereof and with the intermediate portion of the garment substantially accordion folded therebetween, and transferring the formed garments into the elongated cartons while maintaining the accordion folded configuration.

18. The method of treating and handling hosiery articles comprising the steps of loading individual articles onto boarding forms, passing the forms seriatim through a treatment chamber to treat the articles thereon, stripping the treated articles from the forms and delivering the stripped articles into the open end of a pneumatic conveyor, conveying the articles to a forming station, forming the individual articles into a forming chamber by use of pneumatic pressure differential, conveying open cartons seriatim past a filling station adjacent said forming station, transferring the formed articles from said forming chamber into said open cartons, and subsequently closing said open cartons.

19. In a packaging apparatus including conveyor means for conveying empty open containers seriatim past a filling station, a filling mechanism for packaging pliable articles into the open containers at said filling station comprising, article conveyor means for delivering randomly orientated pliable articles to a forming station adjacent said filling station, a forming chamber mounted at said forming station, pneumatic pressure differential means for packing a randomly oriented pliable article into said forming chamber to form the article into the general configuration of said forming chamber, said transfer means for transferring said formed article from said forming chamber into an empty container positioned at said filling station.

20. The packaging apparatus defined in claim 19 wherein said article conveyor means comprises a pneumatic conveyor conduit, and means for creating a flow of air through said conduit to deliver the articles to be packaged to said forming station.

21. The packaging apparatus defined in claim 19 wherein said pneumatic pressure differential means comprises means for applying a vacuum within said forming chamber.

22. The packaging apparatus as defined in claim 21 further comprising a plurality of apertures formed in a wall of said forming chamber, said means applying a vacuum within said forming chamber being operable to withdraw air through said apertures.

23. The packaging apparatus as defined in claim 22 wherein said plurality of apertures are formed in at least two opposed side walls of said forming chamber, said at least two side walls extending in the direction of movement of an article into said forming chamber.

24. The packaging apparatus as defined in claim 23 wherein said forming chamber comprises a generally rectangular tubular member having an open inlet at one end and an open outlet at the opposed end, and means for closing said open outlet to permit the forming of an article in said chamber and for opening said outlet to permit the formed article to be discharged therethrough.

25. The packaging apparatus as defined in claim 19 wherein said forming chamber comprises an elongated tubular member with at least one end wall thereof open to define an inlet through which the pliable articles are received in said forming chamber, and an outlet through which the formed articles are transferred by said transfer means.

26. The packaging apparatus as defined in claim 25 wherein both ends of said forming chamber are open, with one open end defining an inlet for said chamber and the opposed open end defining an outlet for said chamber, and means for closing said outlet to permit an article to be formed therein and for opening said outlet to permit the formed article to be telescoped therethrough.

27. The packaging apparatus as defined in claim 26 wherein said transfer means comprises means for applying a force through said open inlet to the formed article to telescope the formed article through said outlet.

28. The packaging apparatus as defined in claim 27 wherein said means applying said force through said open inlet comprises plunger means for projecting through said inlet, and fluid motor means for projecting and retracting said plunger.

29. The packaging apparatus defined in claim 25 further comprising means for moving said forming chamber between a filling position for receiving a pliable article through said inlet and a discharge position for discharging the formed article through said outlet.

30. The packaging apparatus as defined in claim 29 wherein said means for conveying empty containers seriatim past said filling station comprises means for intermittently advancing the containers one at a time to said filling station to receive a formed article telescoped therein from said forming chamber at said

discharge position, and means coordinating movement of said conveyor means and said means for moving said forming chamber.

31. In a cartoning apparatus including a magazine adapted to contain a supply of empty cartons in a flat folded condition, a carton feeding mechanism adapted to feed cartons one at a time from said magazine, a carton erecting mechanism for erecting the individual cartons, a carton conveyor movable along an endless path to move the erected cartons from said magazine successively past said carton erecting mechanism and a carton filling station to a discharge station, a filling mechanism for depositing pliable articles in the erected cartons at said filling station comprising, a vacuum forming chamber for receiving individual pliable articles and forming the articles into a configuration generally corresponding to the configuration of the interior of an erected carton, pneumatic conveyor means for delivering the individual articles into said forming chamber, and means for transferring the formed article from said forming chamber directly into an open carton at said filling station whereby the pliable article substantially uniformly fills the carton.

32. In the cartoning apparatus as defined in claim 31 the further improvement wherein said forming chamber has one open end wall, means supporting said forming chamber with said open end wall positioned adjacent the open end of a carton at said filling station to permit a formed article to be telescoped therethrough into said carton, and means closing said open wall to permit the forming of an article in said chamber.

33. In a cartoning apparatus as defined in claim 32, the further improvement wherein said pneumatic conveyor means comprises an elongated conveyor conduit having an open inlet, a horizontal feed platform having an opening extending therethrough and communicating directly with said open inlet, and means creating a flow of air through said conduit from said feed opening whereby a pliable article positioned on said horizontal platform with a portion thereof extending over said feed opening will be drawn through said conduit by said flow of air and delivered to said forming chamber.

34. An apparatus for packaging panty garments into elongated, generally rectangular open cartons comprising means for conveying the open cartons seriatim past a filling station, pneumatic conveyor means for conveying the panty garments toes first and with the legs in side-by-side relation through the conveyor to a forming station, an elongated generally rectangular forming chamber having an internal configuration substantially corresponding to the internal configuration of said cartons, vacuum means for drawing said panty garments into said forming chamber with the toes thereof at one end of the chamber and forming the garments therein in a substantially accordion folded configuration extending from the toes at said one end to the open top of the garment at the opposite end of the chamber, and means for transferring the formed garments into said open containers while maintaining said accordion folded configuration.

35. The packaging apparatus as defined in claim 34 wherein said forming chamber is in the form of an elongated rectangular tubular conduit having an open end defining an inlet for the panty garments, a plurality of apertures extending through and positioned substantially over the entire surface of two opposed side walls of said forming chamber, and means evacuating air from said forming chamber through said plurality of apertures formed in said side walls.

36. The packaging apparatus defined in claim 35 wherein said means for transferring the formed garments comprises plunger means projecting through an opening in one end of said forming chamber to push the formed garment from the other end of said chamber directly into the open end of a container.

37. A panty hose processing and handling system comprising, in combination, semi-boarding means for semi-boarding individual panty hose garments, packaging means for packaging individual, semi-boarded panty hose garments into cartons, and garment conveyor means for conveying semi-boarded panty hose garments from said semi-boarding means with the legs thereof extending in side-by-side relation and delivering the conveyed garments to said packaging means, said semi-boarding means including a plurality of collapsible boarding forms, a form conveyor for moving the forms about an endless path past a loading station through a treatment chamber and past a stripping station, means for collapsing the boarding forms at said stripping station, and means at said stripping station to strip the semi-boarded panty hose garments from the collapsed forms.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,704,565 Dated December 5, 1972

Inventor(s) John W. Glaze Jr.

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

Claim 12 should depend from claim 11 and not claim 7.

Claim 12, lines 4-5, "conveying" should be --conveyor--.

Claim 14 should depend from claim 7 and not claim 9.

Signed and sealed this 30th day of April 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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