United States Patent [19]

Stringer et al.

[11] **3,750,916**

[45] **Aug. 7, 1973**

[54] **FOLDING APPARATUS**

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[73] Assignee: **Kellwood Company**, St. Louis, Mo.

[22] Filed: **Sept. 20, 1971**

[21] Appl. No.: **181,875**

[52] **U.S. Cl.** **223/37**, 53/117

[51] **Int. Cl.** **A41h 33/00**

[58] **Field of Search** ..... 53/117, 21 R, 21 FW; 223/37, 38, 1, 2

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Primary Examiner—Geo. V. Larkin

Attorney—Koenig, Senniger, Powers and Leavitt

[57] **ABSTRACT**

Apparatus for folding limp merchandise, such as hosiery, panty hose, or other items of apparel for packaging, in which the merchandise is placed on a conveyor belt with end portions of the merchandise on a pair of platforms on opposite sides of the belt. A card may be placed on the portion of the merchandise between the platforms. One platform is moved inwardly over the belt to fold over the respective end portion of the merchandise and then returned to its retracted position alongside the belt, after which the other platform is moved inwardly over the belt to fold over the other end portion of the merchandise and then returned to its retracted position alongside the belt. As each platform moves inwardly, it is tilted to be inclined downwardly from its outer end.

32 Claims, 25 Drawing Figures

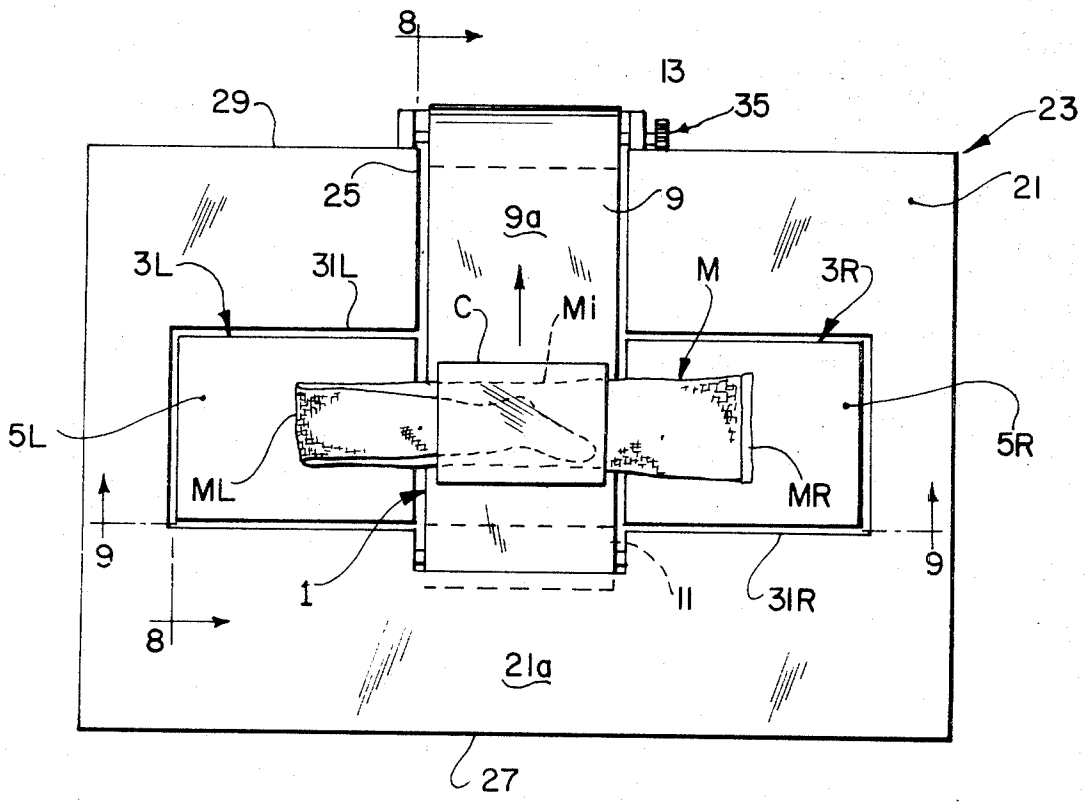


FIG. 1

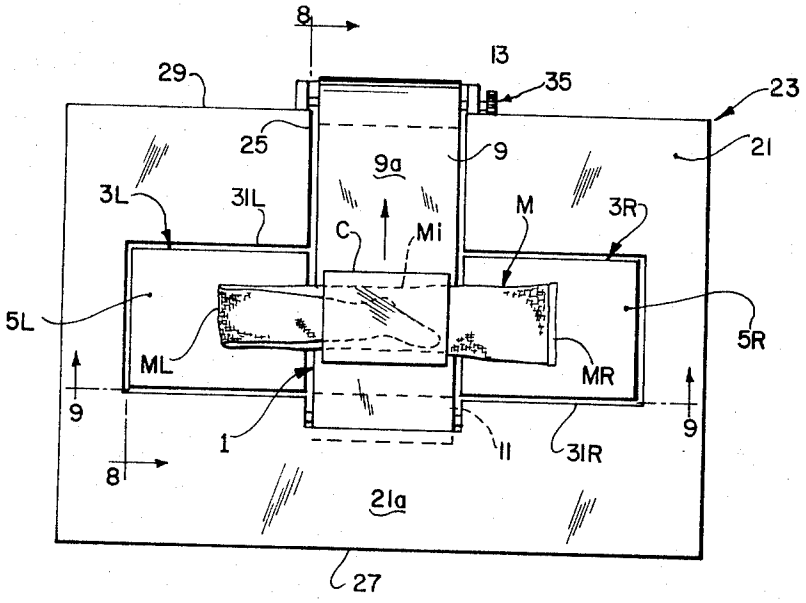


FIG. 2

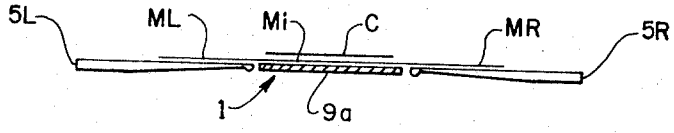


FIG. 3

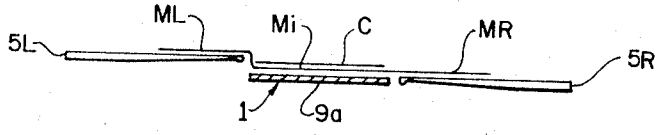


FIG. 4

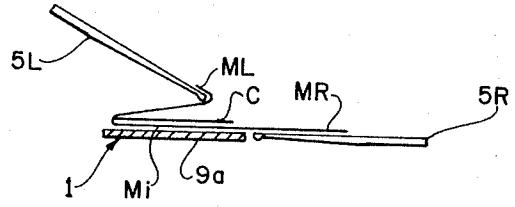


FIG. 5

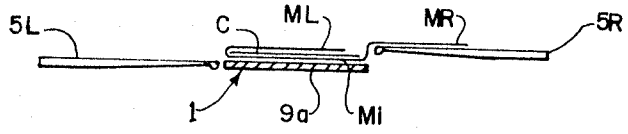


FIG. 6

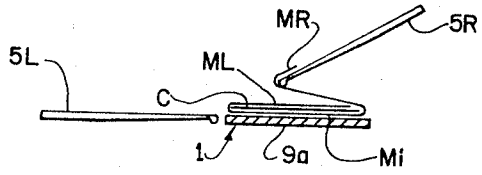


FIG. 7

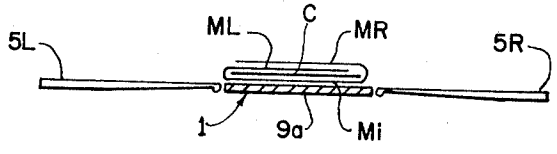
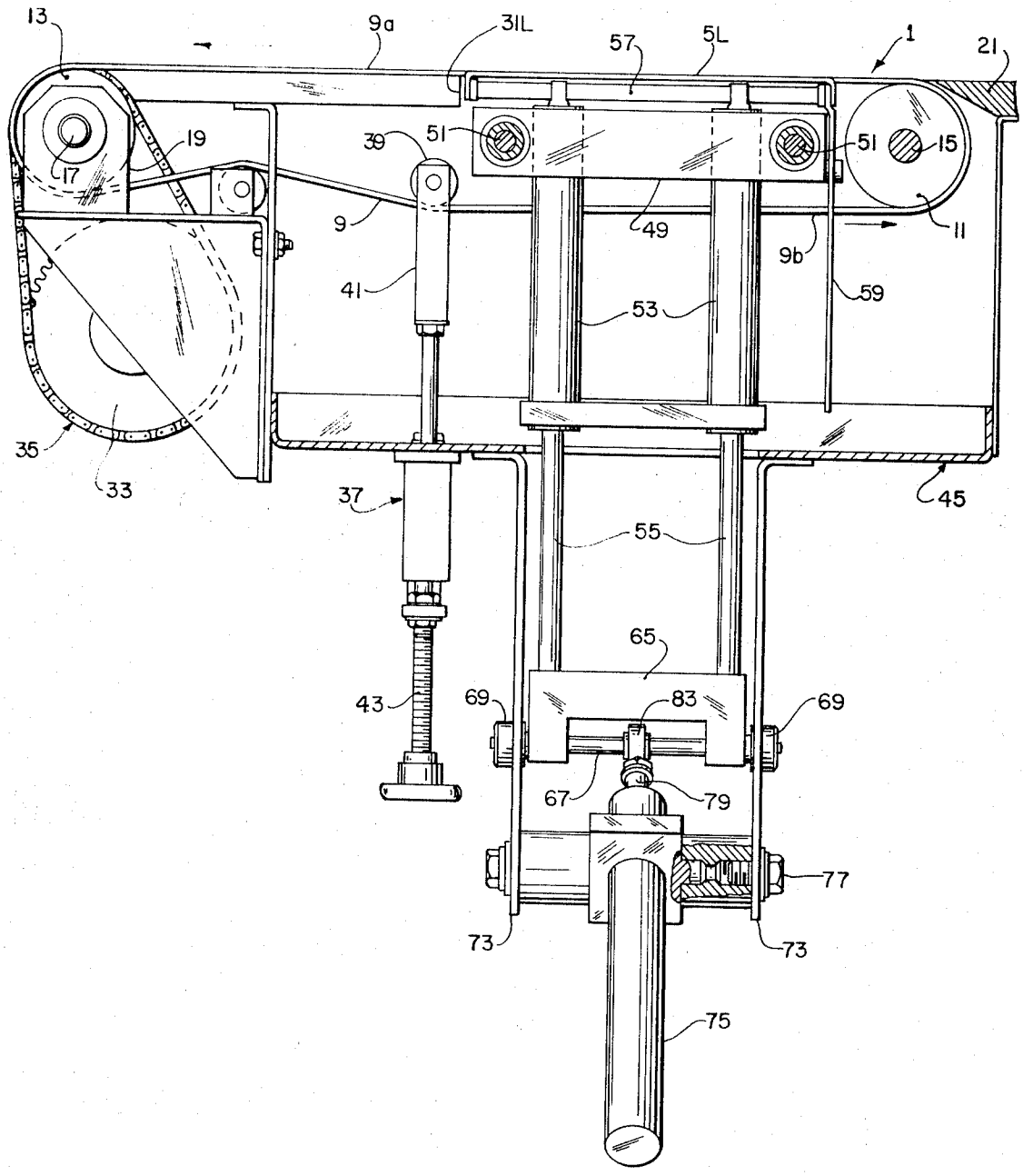


FIG.8



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Robert W. Elderbaum,
Inventors.
Koenig, Senniger, Powers and Leavitt,
Attorneys.

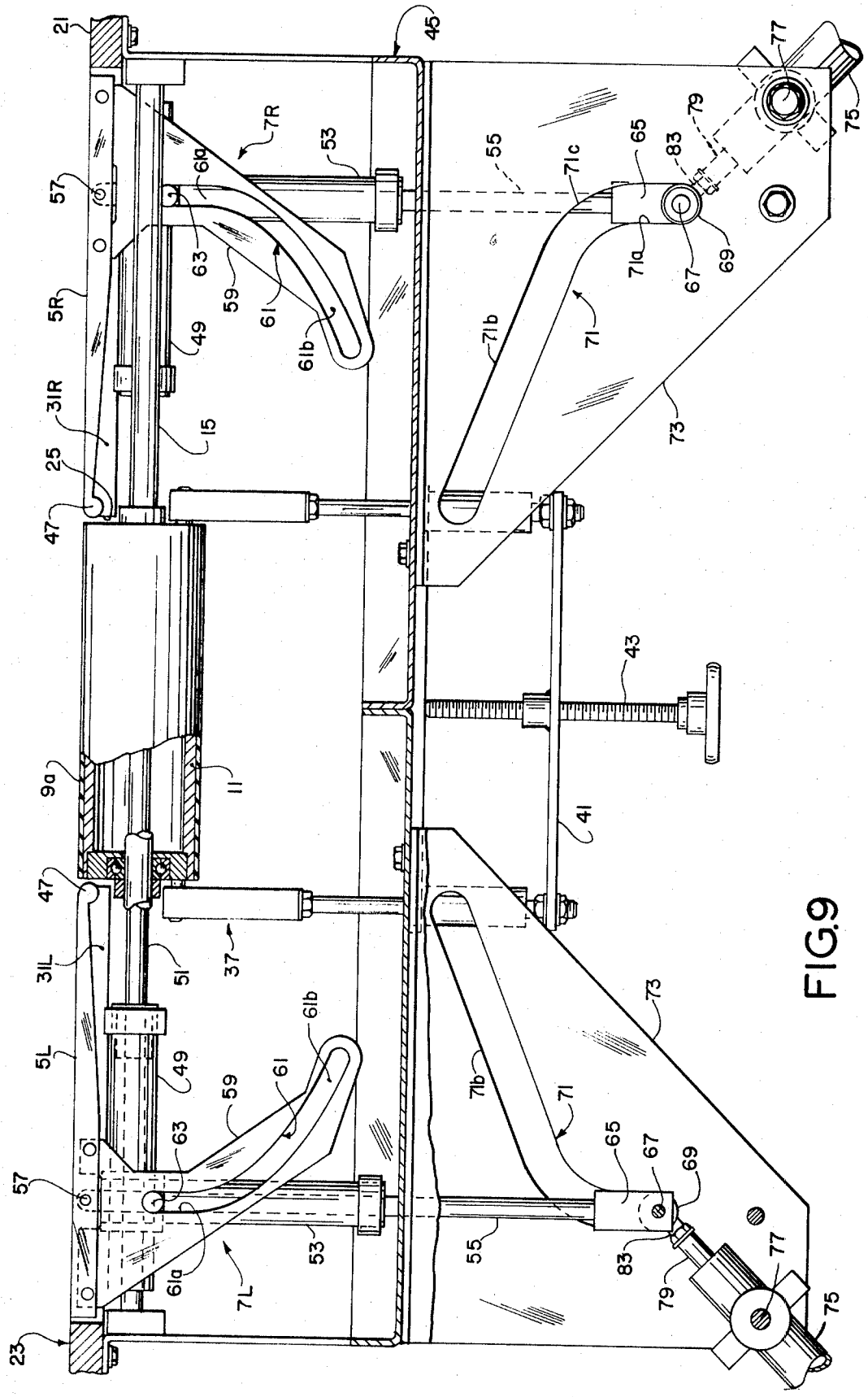
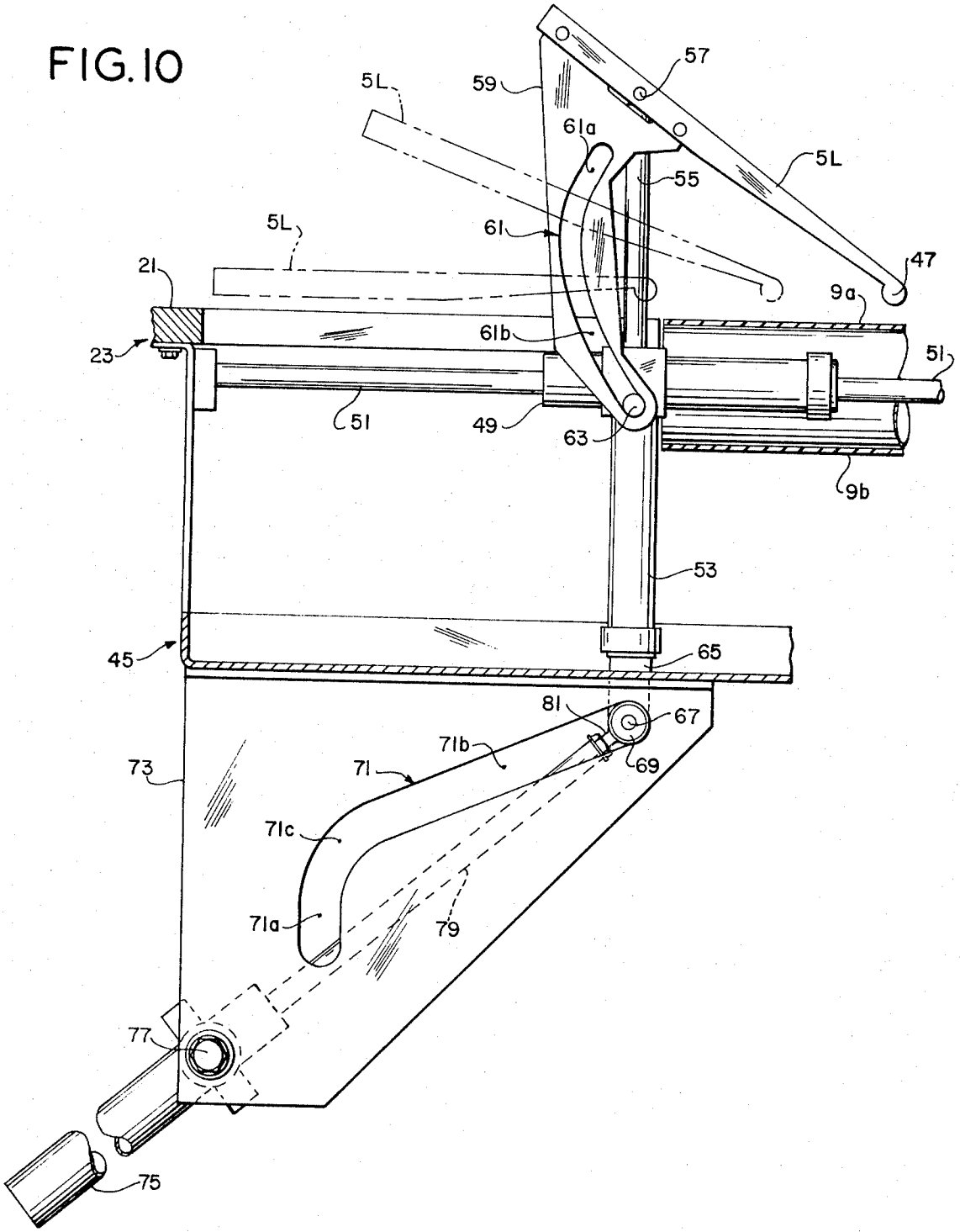

21
45
77
75
79
7R
53
55
65
83
57
61a
71c
63
59
61
61b
71a
67
69
5R
49
71b
71
31R
15
73
25
47
43
9a
11
41
47
37
31L
51
61b
73
5L
49
59
61
71b
71
63
65
67
69
57
53
55
83
77
61a
7L
79
75
23

FIG.9

FIG. 10


5L
59
57
61a
5L
55
5L
61
47
21
9a
61b
23
51
51
49
63
9b
53
45
65
81
67
71b
69
73
71
71c
71a
79
77
75

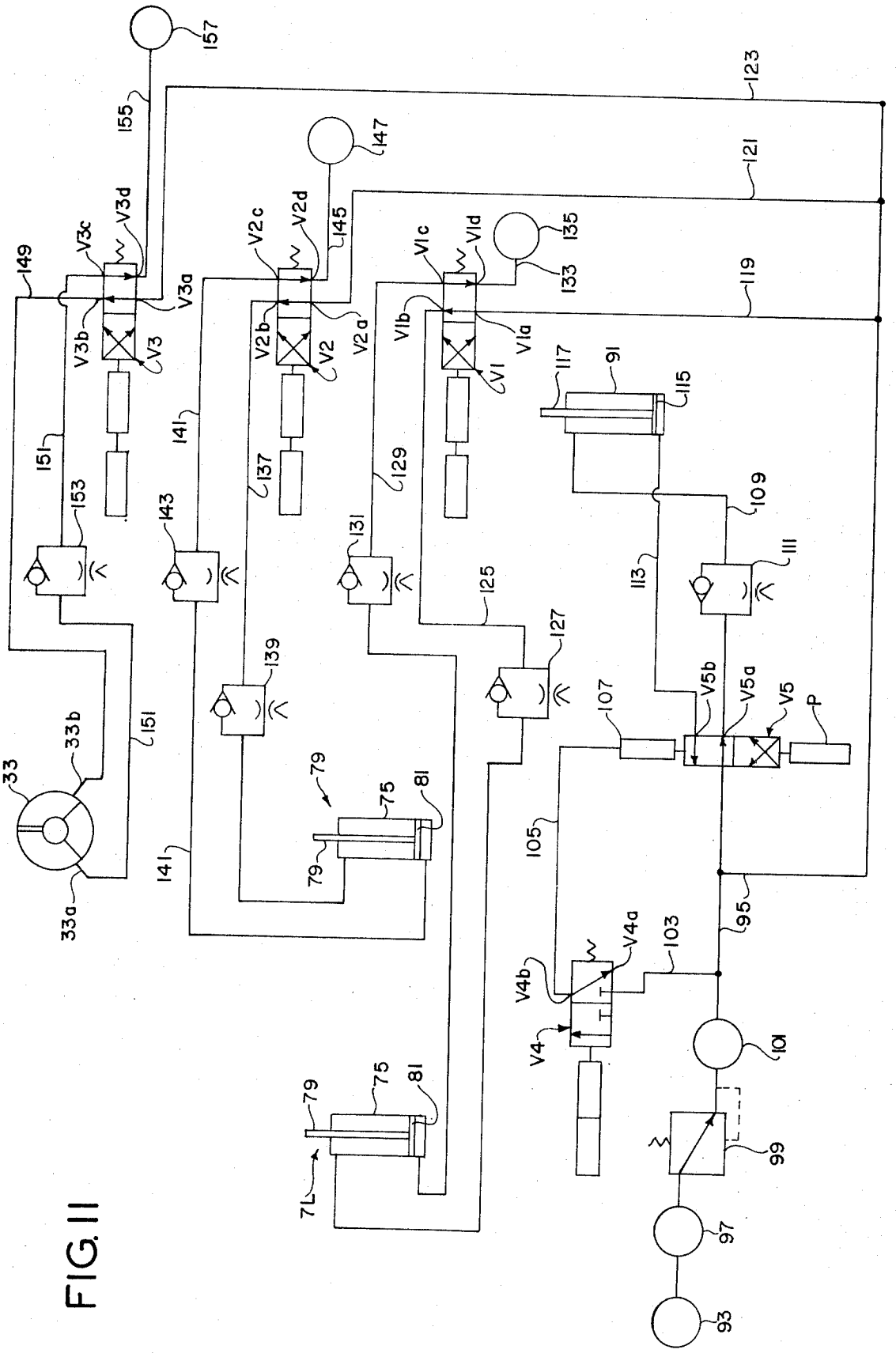

157
155
147
123
121
145
135
133
119
149
V3c
V3d
V2c
V2d
V1c
V1d
V3a
V2a
V1a
V3b
V2b
V1b
V3
V2
V1
117
91
115
151
141
137
129
153
143
131
109
113
111
125
127
139
107
V5b
V5a
V5
P
33
33b
79
75
81
105
141
33a
95
V4a
103
V4b
V4
101
99
7L
97
93

FIG. 11

FIG. 13

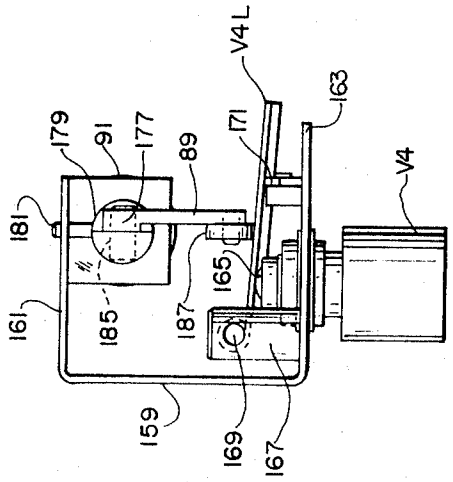


FIG. 14

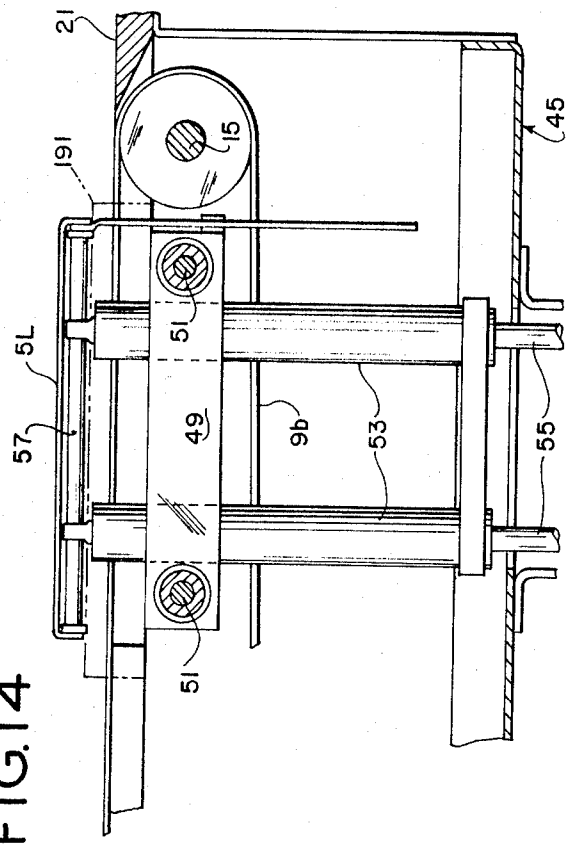
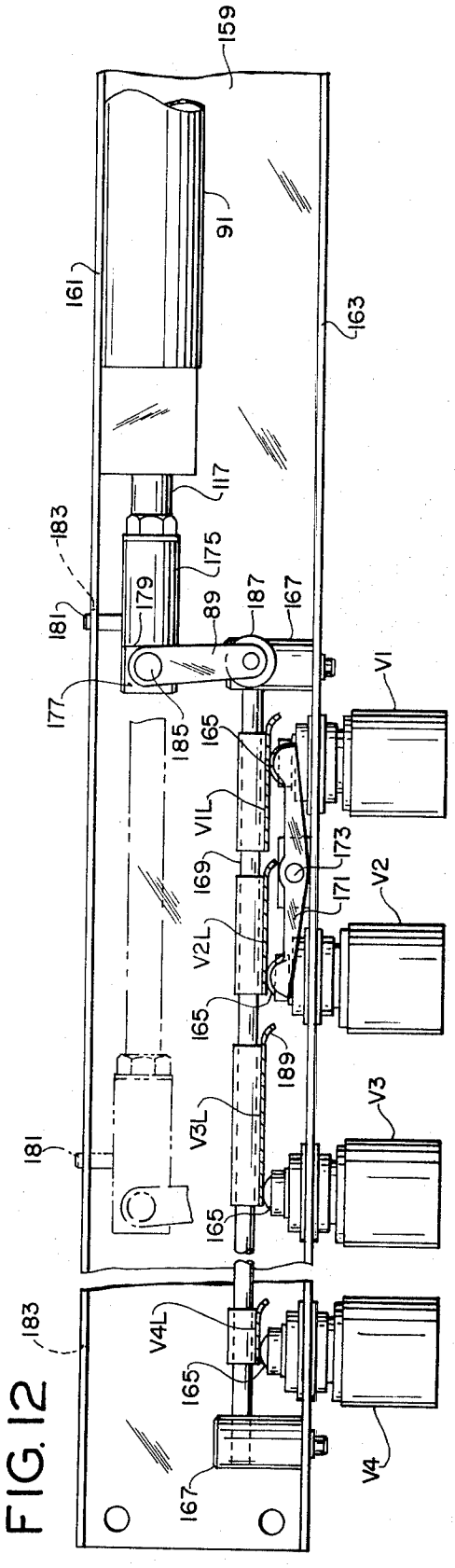


FIG. 12



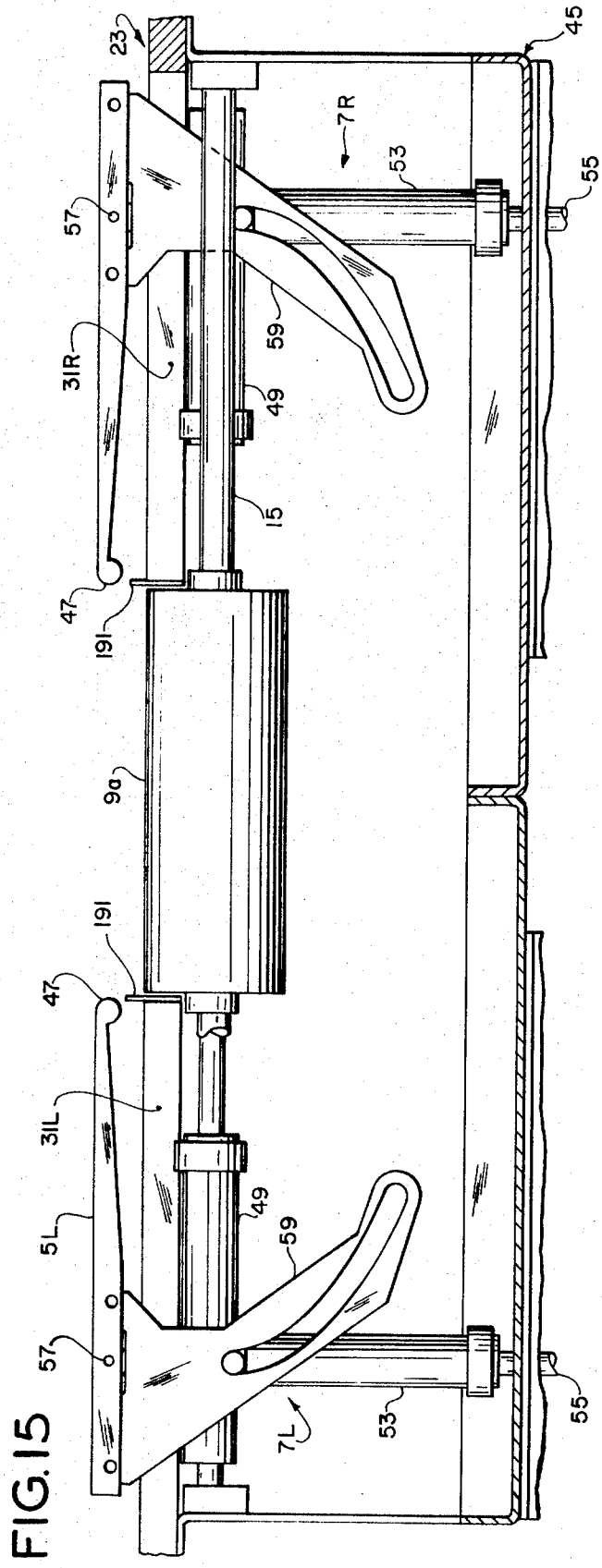


FIG. 15

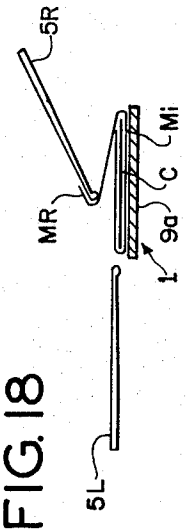


FIG. 18

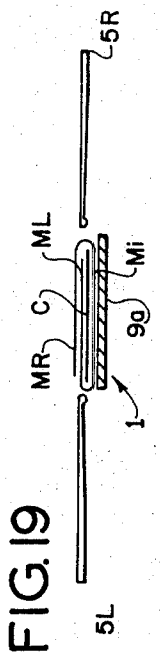


FIG. 19

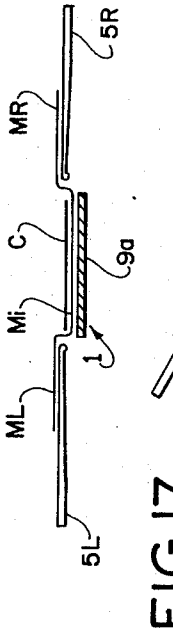


FIG. 16

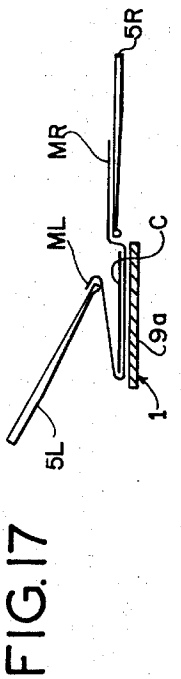


FIG. 17

FIG.20

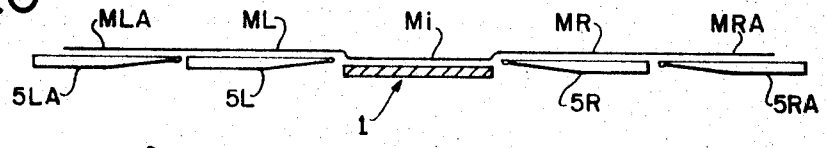


FIG.21

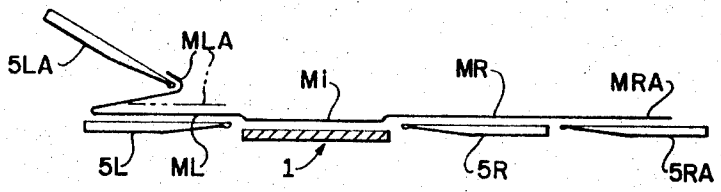


FIG.22

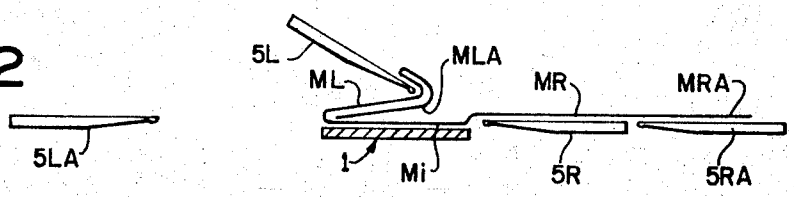


FIG.23

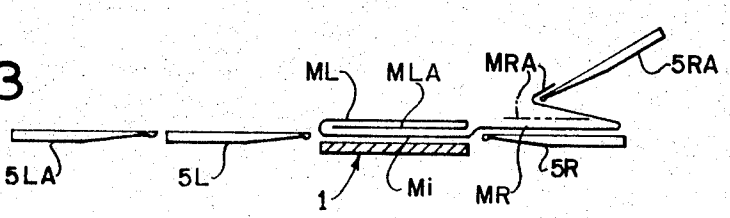


FIG.24

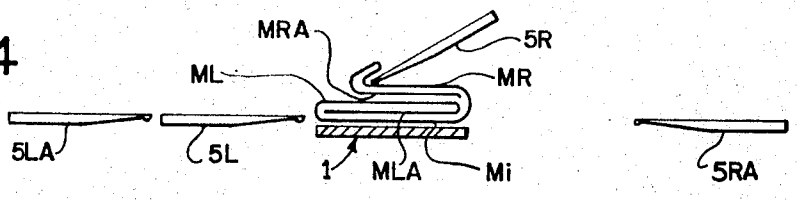
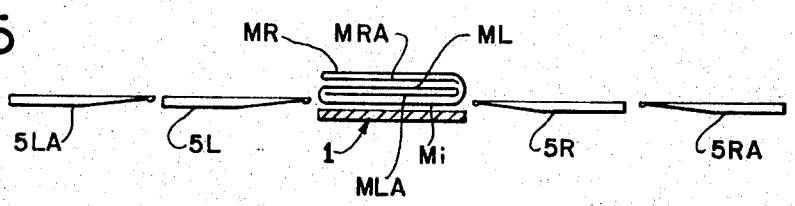


FIG.25



FOLDING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to folding apparatus, and more particularly to apparatus for folding limp merchandise, such as hosiery, panty hose, and other items of apparel.

The invention is especially concerned with the automation of the operation of folding hosiery and panty hose, and more particularly the folding of such merchandise on a card, for subsequent packaging in an envelope or plastic film, this operation heretofore having generally been carried out by hand.

Reference may be made to U.S. Pat. Nos. 3,290,855, 3,310,930, 3,514,019 and 3,516,582 as prior art in this field.

SUMMARY OF THE INVENTION

Among the several objects of this invention may be noted the provision of improved apparatus for folding hosiery, panty hose, or other limp merchandise, accomplishing automatically what has heretofore been generally carried out by hand; the provision of such apparatus particularly for folding the merchandise on a card; and the provision of such apparatus which accomplishes the folding in a predictable and controlled manner without damaging the merchandise. In general, apparatus of this invention in its basic essentials comprises means for supporting the merchandise, such as a pair of women's stockings, with one portion of the merchandise which is to be folded over to lie above another portion of the merchandise extending outwardly on one side of the supporting means, and means for folding over this one portion of the merchandise to lie above the other portion thereof comprising a platform movable away from a retracted position at the said one side of the supporting means inwardly over the supporting means and then back to its retracted position whereby the merchandise may be placed in position for a folding operation on the supporting means with said one portion thereof supported on the platform, after which the platform may be moved in the manner stated to fold over said one portion. Other objects and features will be in part apparent and in part pointed out hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a folding apparatus made in accordance with this invention;

FIGS. 2–7 are semi-diagrammatic views illustrating successive steps in the operation of the apparatus to fold merchandise around the ends of a card;

FIG. 8 is an enlarged longitudinal section on line 8—8 of FIG. 1;

FIG. 9 is an enlarged transverse section on line 9—9 of FIG. 1;

FIG. 10 is a fragment of FIG. 9 illustrating moved positions of a platform of the apparatus;

FIG. 11 is a diagram of a pneumatic circuit of the apparatus;

FIG. 12 is a detail of a timing mechanism of the apparatus;

FIG. 13 is a left end view of FIG. 12;

FIG. 14 is a view similar to FIG. 8 showing a modification;

FIG. 15 is a view similar to FIG. 9 showing the FIG. 14 modification;

FIGS. 16–19 are semi-diagrammatic views illustrating successive steps in the operation of the FIG. 15 apparatus to fold merchandise around the ends of a card; and

FIGS. 20–25 are semi-diagrammatic views illustrating a modification for making four folds and its sequence of operation.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, first more particularly to FIGS. 1 and 8–10, apparatus made in accordance with this invention particularly for folding elongate limp merchandise such as women's hosiery and panty hose on cards is shown basically to comprise means generally indicated at 1 for supporting the merchandise M with one end portion ML of the merchandise extending outwardly on one side of the supporting means (the left side as viewed in FIGS. 1 and 9), and with the other end portion MR extending outwardly on the other side of the supporting means. At 3L is indicated means for folding the end portion ML of the merchandise around one end of a card C placed on the intermediate portion Mi of the merchandise lying on the supporting means 1, and at 3R is indicated means for folding the other end portion MR of the merchandise around the other end of the card (after the folding over of the end portion ML). Each folding means 3L and 3R comprises a platform 5L and 5R, respectively, and means generally designated 7L and 7R, respectively, mounting each platform for movement and for moving it away from a retracted position at its respective side of the supporting means 1 inwardly over the supporting means and then back to its said retracted position, whereby the merchandise M may be placed in position for a folding operation on the supporting means with end portion ML thereof supported on platform 5L (the left-hand platform as viewed in FIGS. 1 and 9) and end portion MR thereof supported on the other platform 5R, after which a card C may be placed on the intermediate portion Mi of the merchandise which lies on the supporting means 1, platform 5L moved in the manner stated (i.e., to the right) to fold end portion ML of the merchandise around the left end of the card to lie above the card (and portion Mi of the merchandise), and platform 5R moved in the manner stated (i.e., to the left) to fold end portion MR of the merchandise around the right end of the card to overlie the folded-over end portion ML. As will be subsequently described in detail, each mounting and moving means 7L and 7R includes means for tilting the respective platform 3L or 3R to be inclined downwardly from its outer end when it moves inwardly.

The supporting means 1 as herein illustrated comprises an endless belt conveyor constituted by an endless belt 9 trained around rolls 11 and 13 journalled on horizontal shafts 15 and 17 mounted at their ends as indicated at 19 underneath the top 21 of a table 23. The top 21 of this table 23 has a relatively wide slot 25 therein extending from adjacent one edge 27 thereof constituting what may be termed its front edge all the way to its opposite or rear edge 29. It also has a pair of rectangular openings 31L and 31R at opposite sides of the slot 25 adjacent the front end of the slot, these openings being dimensioned slightly larger than the

platforms 3L and 3R (which are rectangular). The openings 31L and 31R open at their inner ends into the slot, as shown best in FIG. 1. The shaft 15 extends transversely of the slot 25 and just below the table top 21 adjacent the front end of the slot, and the shaft 17 extends transversely of the slot and just below the table top at the rear end of the table top. Roll 11 projects up into the slot 25, and rolls 11 and 13 have their tops just below the plane of the upper surface of the table top 21 so that the belt 9 has a horizontal upper reach 9*a* (which constitutes the supporting means 1 proper) extending from the front to the rear end of the slot. The portion 21A of the table top 21 in front of the openings 31L and 31R and the front end of the slot 25 provides space for holding merchandise to be folded and to be handled by a worker seated at the front of the table. The belt 9 is adapted to be driven in the direction for forward movement of its upper reach 9*a* (in the direction indicated by the arrows in FIGS. 1 and 8) from a motor 33 via chain and sprocket drive generally indicated at 35. Means for tensioning the belt is indicated generally at 37. This includes a belt tensioning roller 39 engaging the inside of the lower (return) reach of the belt carried by a yoke 41 and adapted to be forced downwardly for tensioning the belt by means of a screw 43 having its upper end engaging a frame structure 45 below the table top 21.

Each platform 5L and 5R is of rectangular shape with a rounded inner edge 47. Each of the mounting and moving means 7L and 7R for the platforms comprises a carriage 49 slidable laterally inwardly and outwardly at the respective side of the table 23 on a pair of parallel horizontal guide rods 51 extending transversely of the table 23 underneath the table top 21. These rods 51 are located in vertical transverse planes between the front and rear edges of the openings 31L and 31R and extend between the upper reach 9*a* and the lower return reach 9*b* of the belt 9. Each carriage carries a pair of vertical tubular guides indicated at 53 located on the inside of rods 51. The two guides 53 of each pair are in a vertical plane parallel to the belt 9. Rods 55 are vertically slidable in these guides. Each platform 5L and 5R is pivotally mounted at the upper end of the respective pair of rods 55 by means of a pin 57, enabling tilting of the platform about an axis transverse to the length of the platform (i.e., parallel to the belt 9).

Extending down from each platform 5L and 5R at one side thereof and at the respective side of the carriage 49 (the front side as herein illustrated) is a curved cam plate 59 having a cam slot 61 therein receiving a follower pin 63 which extends outwardly from the side of the carriage. The slot 61 has an upper vertical end portion 61*a* and a lower curved portion 61*b* extending downwardly and inwardly from the lower end of portion 61*a*. When the rods 55 are down in a lowered retracted position (FIGS. 8 and 9), the upper end of portion 61*a* of slot 61 engages the pin 63, and the platform occupies a lowered retracted position in which it lies horizontally within the respective opening 31L or 31R, generally flush with the upper reach 9*a* of the belt 9. When the rods 55 are raised, the platform is first raised a distance corresponding to the height of vertical portion 61*a* of slot 61 without being tilted (i.e., it remains horizontal) and then as it is raised further, it is tilted by reason of the shape of portion 61*b* of the cam slot to be inclined downwardly from its outer end.

The pair of rods 55 of each of the mounting and moving means 7L and 7R extends upwardly from a clevis 65. A shaft 67 extends through the sides of the clevis and has cam follower rollers 69 at its ends on the outside of the sides of the clevis rolling in cam slots 71 in a pair of fixed cam plates 73 which extend down from the aforesaid frame structure 45 on opposite sides of the clevis. Each cam slot 71 has an outer vertical end portion 71a and a portion 71b inclined upwardly from the upper end of the end portion 71 in the direction toward the longitudinal central plane of the belt 9 (and table 23), with a curved transition 71*c*. The arrangement is such that, with the cam follower rollers 69 at the lower end of the vertical end portions 71*a* of the respective pair of cam slots 71, the clevis 65 and the pair of rods 55 occupy a lower and outer retracted position. The clevis is adapted to move vertically upwardly to raise the rods 55 via vertically upward travel of followers 69 in portions 71*a* of the cam slots 71, then to move laterally inwardly relative to the table 23 and also upwardly as it moves inwardly via travel of the followers 69 in portions 71*c* and then in portions 71*b* of the cam slots 71. For moving the clevis, there is provided an air cylinder 75 pivoted as indicated at 77 adjacent one end thereof constituting its upper end between the plates 73 at their lower outer corners. A piston rod 79 extends from a piston 81 (see FIG. 11) in the cylinder to a connection at 83 with the shaft 67 of the clevis 65.

Referring now to FIG. 11, the cylinder 75 of the left-hand platform moving means 7L and the cylinder 75 of the right-hand platform moving means 7R are shown to be controlled by valves V1 and V2, respectively. The motor 33 for driving the chain is a pneumatic motor of the type having a vane which swings forward to rotate the output shaft of the motor forward on supply of compressed air to a port 33*a* and venting of a port 33*b*, the vane resetting without backward rotation of the output shaft on supply of compressed air to port 33*b* and venting of port 33*a*. It is controlled by a third valve V3. The three valves V1, V2 and V3 are operated in sequence each for a predetermined time interval with a predetermined time interval between operation of valves V1 and V2 and a predetermined time interval between operation of valves V2 and V3 by a valve actuator 89 (see FIGS. 12 and 13) driven by a timing cylinder 91 (see FIGS. 11–13).

At 93 in FIG. 11 is indicated a source of compressed air which supplies a compressed air line 95 including a filter 97, an air regulator 99 and a lubricator 101. At V4 (see FIGS. 11 and 12) is indicated a return valve operated by the valve actuator 89 after valve V3 for effecting operation of the timing cylinder 91 to return the actuator. A pedal-operated valve V5 controls the operation of the timing cylinder 91, effecting forward movement of the valve actuator 89 to actuate valves V1–V4 in sequence when its pedal is actuated. A line 103 connects the air supply line 95 and the inlet port V4*a* of return valve V4, and a line 105 connects the outlet port V4*b* of valve V4 and a pilot cylinder 107 of the pedal-operated valve V5. A line 109 including an adjustable flow control 111 interconnects a first port V5*a* of valve V5 and the forward end of the timing cylinder 91 and a line 113 interconnects a second port V5*b* of valve V5 and the rearward end of the timing cylinder. The arrangement is such that on operation of the pedal P of valve V5 by the worker seated at table 23, air is supplied from port V5*b* via line 113 to the rearward end

of cylinder 91, and the forward end of cylinder 91 is vented via line 109 and port V5*a*, to effect forward movement of the piston 115 and piston rod 117 of cylinder 91 and of the actuator 89 (which is driven by the piston rod 117). The rate of movement of the piston and piston rod, and hence the timing, is controlled by the flow control 111, which may be adjusted to vary the timing. On operation of valve V4 by the actuator at the end of its forward stroke, air is supplied to the forward end of cylinder 91 and vented from its rearward end to retract the piston rod 117 and the actuator.

Branch lines 119, 121 and 123 connect the air supply line 95 to inlet ports V1*a*, V2*a* and V3*a*, respectively, of valves V1, V2 and V3. A line 125 including an adjustable flow control 127 interconnects port V1*b* of valve V1 and the upper end of the lefthand cylinder 75. A line 129 including an adjustable flow control 131 interconnects the lower end of the left-hand cylinder 75 and port V1c of valve V1, and a line 133 connects exhaust port V1d of valve V1 to a muffler 135. A line 137 including an adjustable flow control 139 interconnects port V2*b* of valve V2 and the upper end of the right-hand cylinder 75. A line 141 including an adjustable flow control 143 interconnects the lower end of the right-hand cylinder 75 and port V2*c* of valve V2, and a line 145 connects exhaust port V2*d* of valve V2 to a muffler 147. A line 149 interconnects port V3*b* of valve V3 to the port 33*b* of the pneumatic motor 33 and a line 151 including an adjustable flow control 153 interconnects port 33*a* of the motor and port V3*c* of valve V3. A line 155 connects exhaust port V3*d* of valve V3 to a muffler 157.

Referring now more particularly to FIGS. 12 and 13, the timing cylinder 91 and valves V1–V4 are shown to be carried by a channel member 159, the cylinder being mounted within the channel member underneath its upper flange 161, and the valves V1–V4 being mounted on the lower flange 163 of the channel member arranged in a row forward of the forward end of the cylinder. Each of the valves V1–V4 has an operating button 165 at its upper end above the flange 163. A pair of posts 167 extending upward from the flange 163 support a pivot rod 169 extending alongside the valves and somewhat above the valve operating buttons 165. Pivoted on this rod and bearing on the buttons are four valve-actuating levers V1L, V2L, V3L and V4L for the four valves V1, V2, V3 and V4, respectively. A lever 171 pivoted intermediate its ends at 173 on the flange 163 has its ends engaging the bottoms of levers V1L and V2L with the arrangement such that when lever V1L is swung down, V2L is swung up, and vice versa.

The piston rod 117 of timing cylinder 91 has a cylindric head 175 at its forward (outer) end, this head being formed with a flat 177 at its forward end, providing a shoulder 179 at the rearward end of the flat. A pin 181 extends up from the head 175, being slidable in a longitudinal slot indicated at 183 in flange 161. The valve actuator 89 comprises an arm pivoted as indicated at 185 on the flat 177 and extending downwardly therefrom, with a roller 187 at its lower end for engagement with levers V1L–V4L (one after another) to actuate valves V1–V4 (one after another) as the arm 89 moves forward. Each of levers V1L–V4L has a downwardly curved rear edge such as indicated at 189 for initial engagement by the roller 187. Arm 89 is held against swinging back (counterclockwise as viewed in FIG. 12) for actuating levers V1L–V4L as it moves forward by its engagement (adjacent its upper end) with the shoulder 179. However, it is free to swing up in clockwise direction as viewed in FIG. 12 on its rearward return movement for returning to its retracted position (shown in solid lines in FIG. 12) without actuating the levers.

Each of the valves V1–V3 is normally set to connect its *a* port to its *b* port and to connect its *c* port to its *d* port, whereby the piston rods 79 of cylinders 75 are retracted, and the vane of motor 33 is retracted. Thus, the platforms 5L and 5R are normally down in their retracted position of FIGS. 1, 2 and 9. When the button of any one of these valves is pushed down (and held down), its *a* port is connected to its *c* port, and its *b* port is connected to its *d* port, and when the button is released, the valve (under internal spring action) returns to its normal setting. The valve V5 is normally set to supply air via its *a* port to the forward end of cylinder 91 and to vent air from the rearward end of cylinder 91 via its *b* port so that valve actuator 89 is normally retracted. When pedal P of valve V5 is pushed down, this is reversed, and then when its pilot cylinder 107 is actuated, valve V5 returns to its said normal setting. The return valve V4 normally blocks flow of air to the pilot cylinder 107, and opens to supply air to cylinder 107 when its button is pushed down.

Operation is as follows:

As above noted, the platforms 5L and 5R are normally down in their retracted position of FIGS. 1, 2 and 9, lying horizontally within their openings 31L and 31R, generally flush with the upper reach 9*a* of the belt 9. The valve actuator 89 is normally back in its retracted position of FIG. 12. The worker, seated at the front of table 23, takes a pair of stockings, for example, and lays them across the rearward end of the upper reach 9*a* of the belt 9 with intermediate portion Mi of the stockings on the belt, the left end portion of the stockings on the lefthand platform 5L, and the right end portion (the thigh portion, as shown in FIG. 1) of the stockings on the right-hand platform 5R. In the case of relatively long stockings, the worker will fold over the toe portion of the stockings as shown in FIG. 1 so that the feet of the pair of stockings overlie the intermediate portion Mi of the stockings. The worker then places a card C on the intermediate portion M*i* (and feet) of the stockings overlying the upper reach 9*a* of the belt 9, the card having a length somewhat less than the width of the belt, and then steps on the pedal P of valve V5. This results in air being supplied via line 113 to the rearward end of the timing cylinder 91 and vented at a controlled rate from the forward end of the cylinder 91 via line 109, so that the piston 115 and piston rod 117 of cylinder 91 are driven forward at controlled speed (as determined by the setting of flow control 111).

As the piston rod 117 moves forward, the roller 187 at the lower end of the actuating arm 89 on the head 175 at the forward end of the piston rod, moving forward therewith, comes into engagement with the actuating lever V1L for valve V1 and thereby holds this valve on for the timed interval that it takes roller 187 to roll over the entire width of the actuating lever V1L. With valve V1 on, air is supplied via ports V1a and V1c and line 129 to the lower (outer) end of the left-hand cylinder 75, and vented from the upper (inner) end of the left-hand cylinder 75 via line 125 and ports V1b and V1d to advance the piston rod 79 of the left-hand

cylinder 75, thereby raising the left-hand rods 55 and moving them inward to raise the left-hand platform 5L and move it inward (see FIGS. 3, 4 and 10). The platform first moves upward without moving inward, and without tilting (see FIG. 3 and note the initial raised platform position shown in phantom in FIG. 10). Then, as cam follower rollers 69 of the left-hand mechanism 7L enter and move along portions 71c and 71b of the cam slots 71, the platform 5L moves inward as well as upward, and is tilted to be inclined downwardly from its outer end as it moves inwardly by the action of the cam plate 59 carried by the platform 5L in conjunction with the respective pin 63. FIGS. 3 and 4 illustrate this inward movement and tilting of platform 5L.

As the left-hand platform 5L is raised, moved inward and tilted, it folds (or wraps) the left-hand portion ML of the stockings around the left-hand edge of the card C (see FIG. 4). The portion ML slides nicely off the lower end 47 of the tilted platform 5L and the folding is effected under completely controlled conditions without damaging the stockings (which are delicate).

The roller 187 at the lower end of arm 89, in moving forward, rolls off the first lever V1L and on to the second lever V1L, as a result of which valve V1 is released and returns to its normal setting in which it supplies air to the upper end and vents the lower end of the left-hand cylinder 75. The piston rod 79 of this cylinder is thereby retracted to return the left-hand platform 5L to its retracted position (see FIG. 5), leaving the portion ML of the stockings folded over on top of the card C. Lever V2L actuates valve V2 and holds this valve on for the timed interval that it takes roller 187 to roll over the entire width of the actuating lever V2L. With valve V2 on, air is supplied via ports V2*a* and V2*c* and line 141 to the lower (outer) end of the right-hand cylinder 75, and vented from the upper (inner) end of the right-hand cylinder 75 via line 137 and ports V2*b* and V2*d* to advance the piston rod 79 of the right-hand cylinder 75, thereby raising the right-hand rods 55 and moving them inward to raise the right-hand platform 5R and move it inward (see FIGS. 5 and 6). The platform first moves upward without moving inward and without tilting (see FIG. 5). Then, as cam follower rollers 69 of the right-hand mechanism 7R enter and move along portions 71c and 71b of the cam slots 71, the platform 5R moves inward as well as upward, and is tilted to be inclined downwardly from its outer end as it moves inwardly by the action of the cam plate 59 carried by the platform 5R in conjunction with the respective pin 63. FIGS. 5 and 6 illustrate this inward movement and tilting of platform 5R.

As the right-hand platform 5R is raised, moved inward and tilted, it folds (or wraps) the righthand portion MR of the stockings around the right-hand edge of the card C (see FIG. 6). The portion MR slides nicely off the lower end 47 of the tilted platform 5R and the folding is effected under completely controlled conditions and without damaging the stockings.

It is preferred that the camming actions of each of the means 7L and 7R be such that the edge 47 of the respective platform 5L or 5R remains nearly in the same horizontal plane (e.g., about one inch above the upper reach 9*a* of belt 9) as the platform moves inwardly over the belt (see FIG. 10).

The roller 187 at the lower end of arm 89, still moving forward, rolls off the second lever V2L, as a result of which valve V2 is released and returns to its normal setting in which it supplies air to the upper end and vents the lower end of the right-hand cylinder 75. The piston rod 79 of this cylinder is thereby retracted to return the right-hand platform to its retracted position (see FIG. 7), leaving the portion MR of the stockings folded over on top of portion ML. The roller 187 then rolls on to the third valve actuator lever V3L and thereby holds valve V3 on for the timed interval that it takes the roller to roll over the entire width of lever V3L. With valve V3 on, air is supplied to port 33*a* and vented from port 33*b* of motor 33 to operate the motor to drive the belt 9 to convey away the card with the stockings folded thereon toward the rear of table 23. The motor continues in operation until roller 187 rolls off lever V3L, at which point valve V3 resets to reset the vane of the motor. The roller 187 then rolls on to lever V4L to actuate valve V4 and thereby, via pilot cylinder 107, reset valve V5 to effect retraction of the piston rod 117 of cylinder 91 and thus to effect return of arm 89 to its retracted position shown in solid lines in FIG. 12. As the arm 89 returns (i.e., moves to the right as viewed in FIG. 12), it swings up in passing over levers V3L, V2L and V1L without actuating them. The apparatus is then ready for the next folding operation.

FIGS. 14–19 illustrate a modification wherein the platforms 5L and 5R, instead of being generally flush with the upper reach 9*a* of the belt 9 when in their retracted position, are at a level above the upper reach of the belt. FIGS. 14–16 show the platforms in this retracted position, and FIGS. 17–19 show the sequence of operation, involving inward movement of the platforms, and raising and tilting thereof as if the cam follower rollers 69 started at the outer (lower) ends of cam slots corresponding generally to portions 71*b* of slots 71, without the initial vertical rise. In the operation of this modification, the worker lays the stockings across the platforms 5L and 5R and, in applying the card C to the intermediate portion M*i* of the stockings, pushes the card and portion M*i* down between the opposed inner edges 47 of the platforms, as illustrated in FIG. 16.

FIGS. 14 and 15 also illustrate the provision of abutment strips 191 spanning the inner ends of openings 31L and 31R at opposite sides of the upper reach 9a of the belt 9 at the folding station, extending upwardly above the upper reach 9*a* for preventing a card C from being pushed laterally to one side or the other by a platform if the card, by chance, should be tilted upwardly when a platform rises.

The upper surfaces and edges 47 of the platforms 5L and 5R are preferably smooth so as to impose as little frictional resistance as possible to the sliding of portions ML and MR off the platforms as the platforms are moved inwardly and tilted, and so as to avoid any snagging of the merchandise. It is contemplated that each platform might even conprise a set of rollers (like a roller conveyor) and it is possible that provision may be made for positively driving the rollers positively to feed portions MR and ML of the merchandise off the platforms.

While as above described the merchandise is folded over around the ends of cards C, it has been found that the apparatus is effectively operable to fold merchandise of the type above described without the use of cards (e.g., to fold over portion ML directly on top of portion Mi, and then to fold over portion MR on top of portion ML).

It is also contemplated that the principles of the invention may be applicable to apparatus for folding merchandise other than hosiery and panty hose; for example, they may be applicable to apparatus for folding such merchandise as T-shirts (wherein the sides of the shirt are folded over either with or without a card, and possibly also the lower end portion of the shirt). Furthermore, it is contemplated that more than two platforms may be used for making more than two folds; for example, additional platforms may be provided laterally outwardly of platforms 5L and 5R to fold end portions of merchandise over on these platforms, followed by operation of platforms 5L and 5R as above described. This type of apparatus and its sequence of operation is illustrated in FIGS. **20–25**, wherein the additional platforms are designated 5LA and 5RA. The sequence involves operation of platform 5LA to fold over portion MLA of the merchandise on ML (FIG. **21**), followed by retraction of platform 5LA and operation of platform 5L to fold over portions MLA and ML on Mi (FIG. **21**), followed by retraction of platform 5L. Then platform 5RA is operated to fold over portion MRA (FIG. **23**) of the merchandise on MR and then retracted, and platform 5R is operated to fold over MRA and MR on ML (FIG. **24**) and then retracted (FIG. **25**).

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Apparatus for folding limp merchandise comprising means for supporting the merchandise with one portion of the merchandise which is to be folded over to lie above another portion of the merchandise extending outwardly on one side of said supporting means, and means for folding over said one portion of the merchandise to lie above said other portion thereof comprising a platform, and means mounting said platform for bodily movement and for moving it bodily away from a retracted position at said one side of said supporting means inwardly over said supporting means, and then back to said retracted position, said platform, when in its retracted position, having one end, constituting its inner end, adjacent said one side of the supporting means and having its other end, constituting its outer end, spaced from said supporting means, said inner end of said platform moving bodily inwardly over said supporting means from said one side thereof as said platform moves bodily inwardly, whereby the merchandise may be placed in position for a folding operation on the supporting means with said one portion thereof supported on the platform, after which the platform may be moved in the manner stated to fold over said one portion of the merchandise.

2. Apparatus as set forth in claim **1** wherein said platform, when in retracted position, is generally flush with said supporting means, and wherein said mounting and moving means includes means for moving the platform upwardly before it moves inwardly.

3. Apparatus as set forth in claim **1** wherein said platform, when in retracted position, is at a level above said ssupporting means.

4. Apparatus as set forth in claim **1** wherein said mounting and moving means includes means for tilting the platform to be inclined downwardly from its outer end when it moves inwardly.

5. Apparatus as set forth in claim **4** wherein said platform, when in retracted position, is generally flush with said supporting means, and wherein said mounting and moving means includes means for moving the platform upwardly before it moves inwardly.

6. Apparatus as set forth in claim **4** wherein said platform, when in retracted position, is at a level above said supporting means.

7. Apparatus as set forth in claim **1** wherein said supporting means comprises a conveyor operable after the folding operation to convey away the folded merchandise.

8. Apparatus as set forth in claim **7** wherein said platform, when in retracted position, is generally flush with said conveyor, and wherein said mounting and moving means includes means for moving the platform upwardly before it moves inwardly.

9. Apparatus as set forth in claim **7** wherein said platform, when in retracted position, is at a level above said conveyor.

10. Apparatus as set forth in claim **7** wherein said mounting and moving means includes means for tilting the platform to be inclined downwardly from its outer end when it moves inwardly.

11. Apparatus as set forth in claim **10** wherein said platform, when in retracted position, is generally flush with said conveyor, and wherein said mounting and moving means includes means for moving the platform upwardly before it moves inwardly.

12. Apparatus as set forth in claim **10** wherein said platform, when in retracted position, is at a level above said conveyor.

13. Apparatus as set forth in claim **1** for folding the merchandise on a card with one end portion of the merchandise folded around one end of the card wherein said supporting means is adapted to support the merchandise with said one end portion thereof extending outwardly on said one side of the supporting means and lying on said platform, whereby the merchandise may be placed in position for a folding operation on the supporting means with said one end portion thereof supported on the platform, after which a card may be placed on the portion of the merchandise lying on said supporting means, and the platform then moved in the manner stated to fold said one end portion of the merchandise around the respective end of the card.

14. Apparatus for folding limp merchandise with end portions of the merchandise folded over one on the other comprising means for supporting an intermediate portion of the merchandise with outer portions of the merchandise extending laterally outwardly on opposite sides of said supporting means, and means for folding over one of said outer portions of the merchandise to lie above said intermediate portion of the merchandise and then folding over the other said outer portion of the merchandise to overlap the first folded-over portion comprising a first platform at one side of said supporting means for supporting said one outer portion of the merchandise, a second platform at the other side of said supporting means for supporting said other outer

portion of the merchandise, and means mounting each platform for movement and for moving it away from a retracted position at its respective side of said supporting means inwardly over said supporting means, and then back to said retracted position, each said platform, when in its retracted position, having one end, constituting its inner end, adjacent its said one side of the supporting means and having its other end, constituting its outer end, spaced from said supporting means, said inner end of said platform moving bodily inwardly over said supporting means from its said one side thereof as said platform moves bodily inwardly, whereby the merchandise may be placed in position for a folding operation on the supporting means with the said outer portions thereof supported on the platforms on opposite sides of the supporting means, after which the first platform may be moved in the manner stated to fold over the said one outer portion of the merchandise and the second platform then moved in the manner stated to fold over the said other outer portion of the merchandise.

15. Apparatus as set forth in claim **14** wherein each said platform, when in its said retracted position, is generally flush with said supporting means, and wherein the mounting and moving means for each platform includes means for moving the platform upwardly before it moves inwardly.

16. Apparatus as set forth in claim **14** wherein each said platform, when in retracted position, is at a level above said supporting means.

17. Apparatus as set forth in claim **14** wherein the mounting and moving means for each platform includes means for tilting the platform to be inclined downwardly from its outer end when it moves inwardly.

18. Apparatus as set forth in claim **17** wherein each platform, when in its said retracted position, is generally flush with said supporting means, and wherein the mounting and moving means for each platform includes means for moving the platform upwardly before it moves inwardly.

19. Apparatus as set forth in claim **17** wherein each said platform, when in retracted position, is at a level above said supporting means.

20. Apparatus as set forth in claim **14** wherein said supporting means comprises an upper horizontal reach of an endless belt conveyor operable after the folding operation to convey away the folded merchandise.

21. Apparatus as set forth in claim **20** wherein each platform, when in retracted position is generally flush with said upper reach, and wherein the mounting and moving means for each platform includes means for moving the platform upwardly before it moves inwardly.

22. Apparatus as set forth in claim **20** wherein said platform, when in retracted position, is at a level above said conveyor.

23. Apparatus as set forth in claim **20** wherein said mounting and moving means includes means for tilting the platform to be inclined downwardly from its outer end when it moves inwardly.

24. Apparatus as set forth in claim **23** wherein said platform, when in retracted position, is generally flush with said upper reach, and wherein said mounting and moving means includes means for moving the platform upwardly before it moves inwardly.

25. Apparatus as set forth in claim **23** wherein said platform, when in retracted position, is at a level above said upper reach.

26. Apparatus for folding limp merchandise with end portions of the merchandise folded over one on the other comprising means for supporting an intermediate portion of the merchandise with outer portions of the merchandise extending laterally outwardly on opposite sides of said supporting means, and means for folding over one of said outer portions of the merchandise to lie above said intermediate portion of the merchandise and then folding over the other said outer portion of the merchandise to overlap the first folded-over portion comprising a first platform at one side of said supporting means for supporting said one outer portion of the merchandise, a second platform at the other side of said supporting means for supporting said other outer portion of the merchandise, means mounting each platform for movement and for moving it away from a retracted position at its respective side of said supporting means inwardly over said supporting means, and then back to said retracted position, whereby the merchandise may be placed in position for a folding operation on the supporting means with the said outer portions thereof supported on the platforms on opposite sides of the supporting means, after which the first platform may be moved in the manner stated to fold over the said one outer portion of the merchandise and the second platform then moved in the manner stated to fold over the said other outer portion of the merchandise, said supporting means comprising an upper horizontal reach of an endless belt conveyor operable after the folding operation to convey away the folded merchandise, said mounting and moving means including means for tilting the platform to be inclined downwardly from its outer end when it moves inwardly, the mounting, and moving means for each platform comprising a carriage movable laterally inwardly with respect to said conveyor away from a retracted position at its respective side of the carriage to an advanced position and then movable back to its retracted position, platform-supporting means carried by each carriage for vertical movement relative thereto, each platform being pivoted at the upper end of its respective supporting means for swinging movement about a horizontal axis extending parallel to the conveyor, means interconnecting each carriage and the respective platform for effecting said tilting of the platform on its said axis as the respective platform-supporting means moves upwardly, and means for raising and lowering each platform supporting means and moving it and the respective carriage inwardly and outwardly.

27. Apparatus as set forth in claim **26** wherein each said raising and lowering means comprises a follower at the lower end of the respective platform-supporting means, fixed cam means guiding the follower for inward and outward and upward and downward movement thereof, and an air cylinder for moving the follower.

28. Apparatus as set forth in claim **27** having means for effecting operation in sequence of one platform, then the other, and then tthe conveyor to convey away the folded merchandise.

29. Apparatus as set forth in claim **26** wherein each tilting means comprises cam means on the respective platform and a follower therefor on the respective carriage.

30. Apparatus as set forth in claim 14 for folding the merchandise on a card with said end portions folded over around opposite ends of the card adapted for placement of a card on said intermediate portion of the merchandise, whereby the merchandise may be placed in position for a folding operation on the supporting means with the said outer portions thereof supported on the platforms on opposite sides of the supporting means, after which a card may be placed on the intermediate portion of the merchandise lying on said supporting means, the first platform then moved in the manner stated to fold said one outer portion of the merchandise around the respective end of the card, and the second platform then moved in the manner stated to fold the said other outer portion of the merchandise around the other end of the card.

31. Apparatus for folding limp merchandise comprising supporting means, an inner platform normally occupying a retracted position on one side of said supporting means, and an outer platform normally occupying a retracted position outward of said inner platform, adapted to receive merchandise with portions thereof lying on said supporting means and said platforms, the outer platform being movable away from its retracted position over the inner platform for folding the portion of the merchandise on the outer platform over on the portion on the inner platform, and then back to retracted position, the inner platform then being movable away from its retracted position over the supporting means for folding the two portions of the merchandise thereon over on the portion on the supporting means, and then back to retracted position.

32. Apparatus as set forth in claim 31 having an inner and an outer platform on the other side of said supporting means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,750,916 Dated August 7, 1973

Inventor(s) Myron Scott Stringer, Daniel W. Smith, Robert G. MacIvergan and Robert W. Elderbaum

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

Front page, item [75], "Robert W. Eldenbaum" should read -- Robert W. Elderbaum --. Column 3, line 22, "belt tensioning roller" should read -- belt-tensioning roller --. Column 5, line 16, "lefthand" should read -- left-hand --. Column 6, line 38, "lefthand" should read -- left-hand --. Column 7, line 24, "V1L" should read -- V2L --. Column 10, line 3 "ssupporting" should read -- supporting --. Column 12, line 62, "tthe" (second occurrence) should read -- the --.

Signed and sealed this 12th day of February 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents