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D'Angelo

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[54] **MULTI-LEVEL APPARATUS FOR FOLDING LARGE FLEXIBLE WEBS**

[76] Inventor: **Joseph John D'Angelo,** 378 Annette Ct., Wyckoff, N.J.

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[52] **U.S. Cl.** **270/69**

[51] **Int. Cl.** **B65h 45/00**

[58] **Field of Search** ..... 270/68 R, 69, 81

[56] **References Cited**

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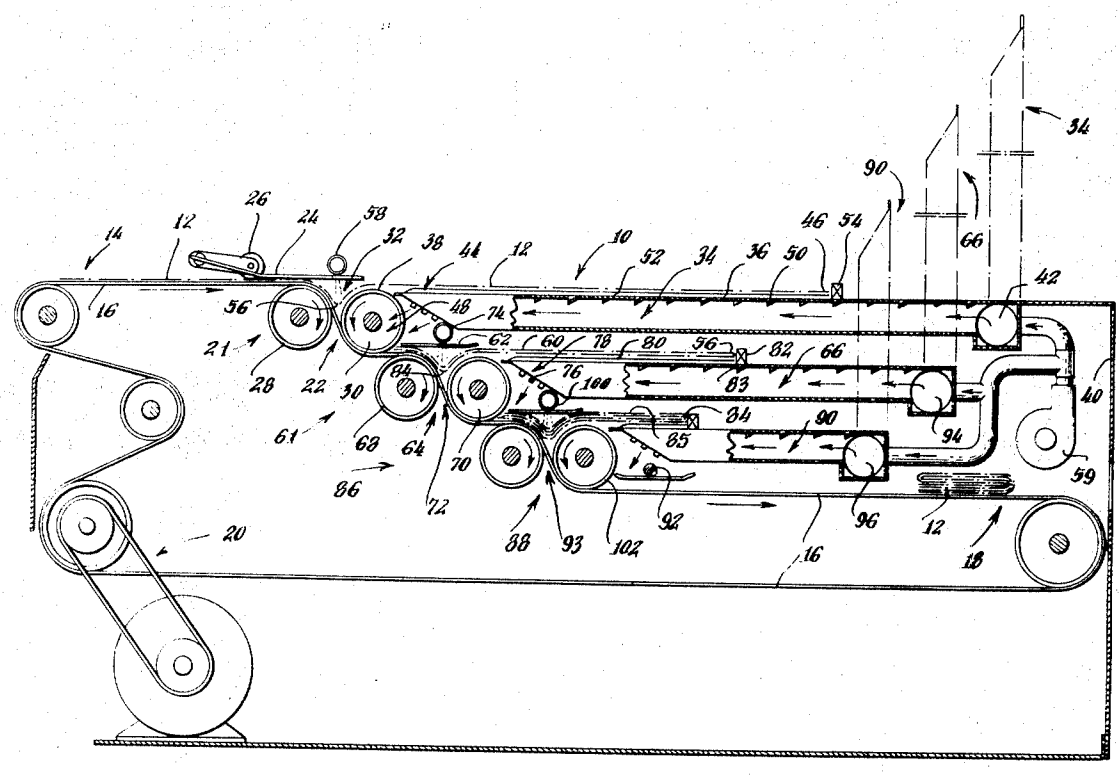
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Primary Examiner—Robert W. Michell
Assistant Examiner—A. Heinz
Attorney—Bryan, Parmelee, Johnson & Bollinger

[57] **ABSTRACT**

A multi-level apparatus for receiving a large flexible web, such as a large plastic bag, and folding it into multiple pre-selected segments in various configurations as may be desired. A plurality of conveyor decks are arranged in a stacked, spaced relationship relative to one another for sequentially receiving the flexible web which is to be folded. An adjustable actuator stop is associated with each conveyor deck for limiting the distance the leading portion of the web can advance along the deck, and conveyor means associated with each conveyor deck propels the flexible web therealong and into contact with the adjustable actuator stop. Counter-rotating elements positioned adjacent the front end of each conveyor deck in substantially longitudinal alignment with the top of the conveyor deck define a receiving slot to receive a pre-selected transverse segment of the flexible web along which it is desired to fold the web. Fold-starting means are included for urging the pre-selected transverse segment into the receiving slot. The adjustable actuator stop is operatively associated with the fold-starting means for actuation thereof, whereby upon engagement of the leading portion with the adjustable actuator stop, the transverse segment is urged into the receiving slot for initiating folding. A conveyor belt snakes between the counter-rotating elements and is arranged for contact therewith to convey the newly folding web therealong, the conveyor belt acting conjointly with the counterrotating elements to introduce a fold along a different preselected transverse segment of the flexible web at each receiving slot, whereby the flexible web may be folded into a plurality of segments of various sizes and configurations, as desired.

2 Claims, 10 Drawing Figures



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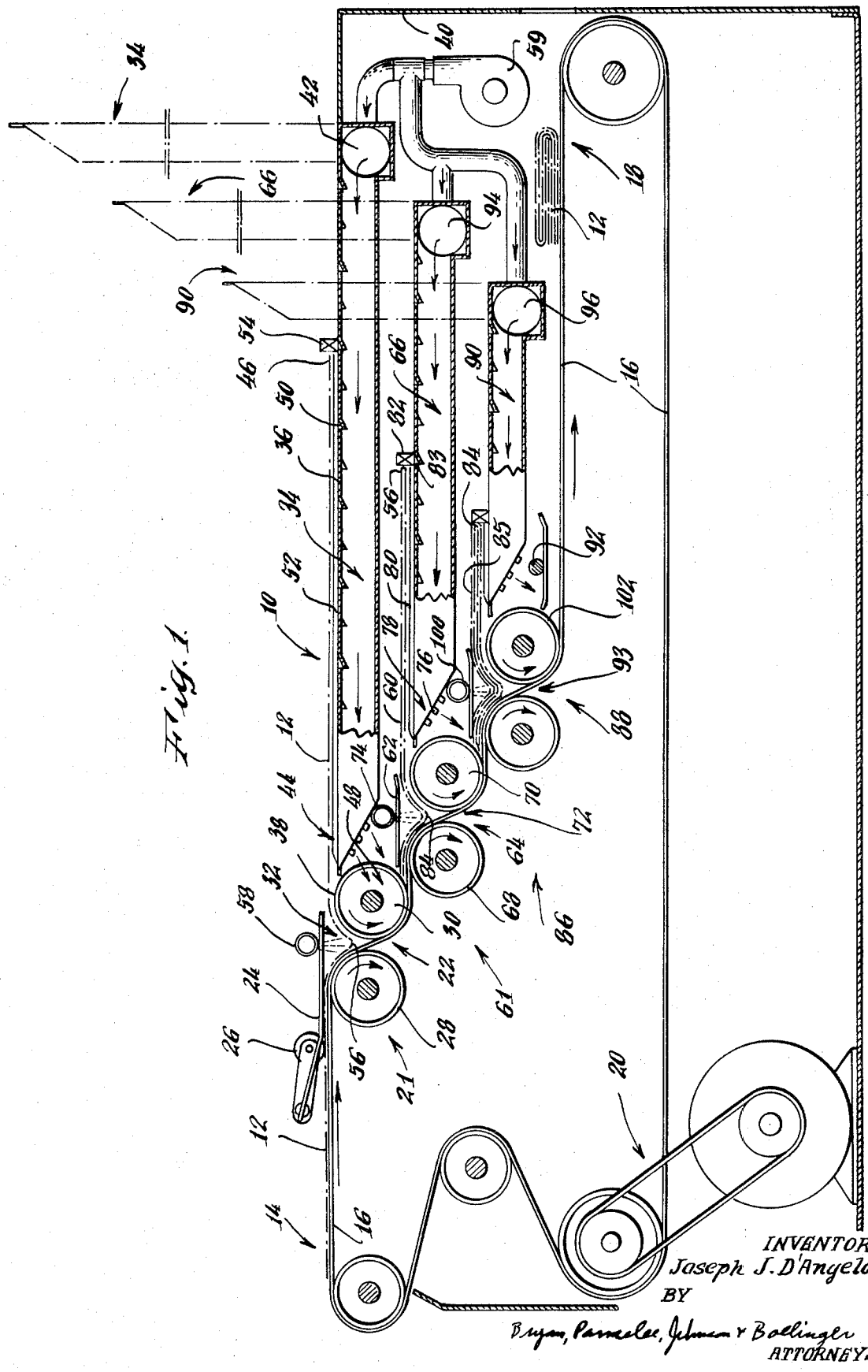


Fig. 1.

INVENTOR
Joseph J. D'Angelo
BY
Bryan, Parmelee, Johnson & Bollinger
ATTORNEYS.

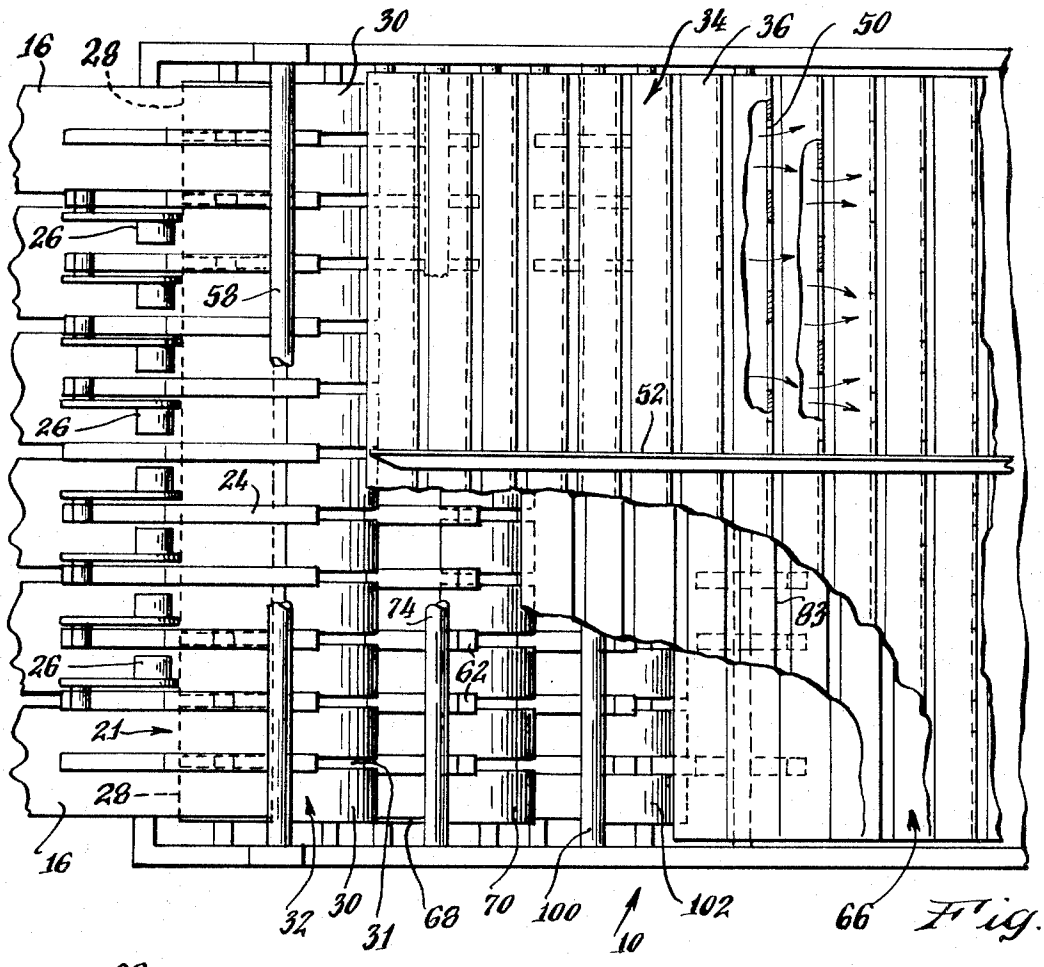


Fig. 2.

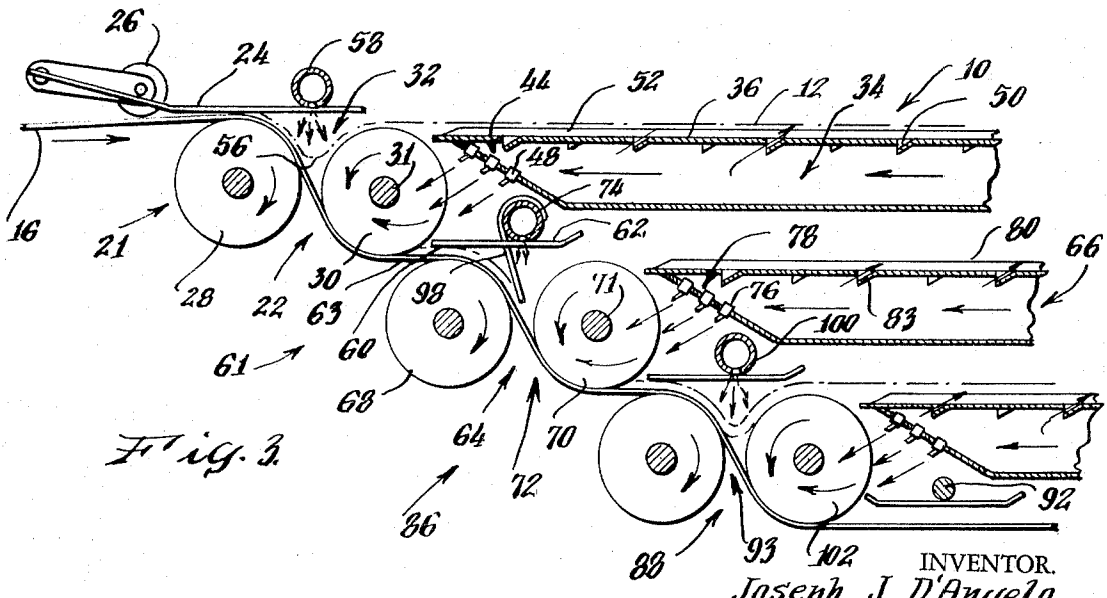


Fig. 3.

INVENTOR.
Joseph J. D'Angelo
BY

Bryan, Pannebee, Johnson & Bollinger
ATTORNEYS

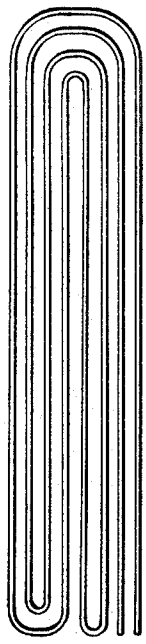


Fig. 8.

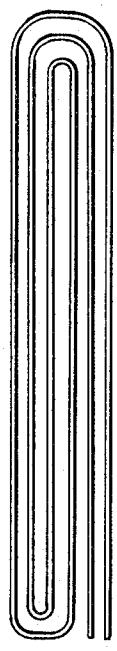


Fig. 9.

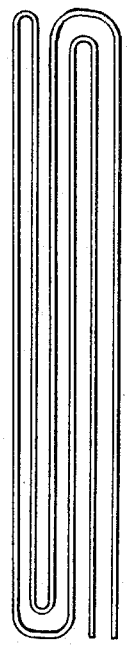


Fig. 10.



Fig. 4.



Fig. 5.



Fig. 6.



Fig. 7.

INVENTOR.
Joseph J. D'Angelo
BY

Bryan, Parmelee, Johnson & Ballinger
ATTORNEYS.

MULTI-LEVEL APPARATUS FOR FOLDING LARGE FLEXIBLE WEBS

DESCRIPTION

The invention relates to an apparatus for folding large flexible webs, for example, large plastic bags such as lawn cuttings and leaf bags, trash bags, disposable garbage bags. The apparatus enables these items to be folded in various sizes and pre-selected patterns for ease in handling and storage.

Prior art devices presently being employed for folding large flexible webs, especially large plastic bags are complex and subject to jamming and generally require elaborate adaptation when being used with conventional web making machines, i.e. bag making machines. That is, the complex prior folding devices have generally required mechanical and electrical interconnections with the bag producing machine itself. Additionally, the prior devices have been limited in use that they generally require additional attachments and elaborate set-up procedures to provide different fold configurations. Further, prior machines have frequencly jammed during operation, and it is difficult and time consuming to "clear" the jam in such machines.

It is among the advantages of the apparatus embodying the present invention that it will readily accommodate different sizes of flexible webs and will produce folded webs of various sizes and configurations and in which the folding pattern can be conveniently and easily pre-selected and changed, as may be desired by the operator.

It is a further advantage of the present apparatus that it may be readily used with any conventional web or bag-making machine with a minimum of preparation and set-up time.

It is another advantage of the present invention in that there are no required mechanical or electrical interconnections with the flexible web or bag producing machine. In other words, a machine embodying the present invention is universal in application.

It is a further advantage of the present invention in that the machine embodying this invention is essentially self-clearing.

It is a further advantage that the present apparatus is simple in construction and operation with few moving parts including a single continuous conveyor belt.

It is a still further advantage that the flexible plastic web being folded is brought into contact with metallic surfaces so that any tendencey toward static build-up on the plastic web is averted.

The invention provides a multi-level apparatus for receiving a large flexible web and folding it into multiple pre-selected segments in various configurations as may be desired by the operator. A plurality of conveyor decks are arranged in a stacked, spaced relationship relative to one another for sequentially receiving the flexible web which is to be folded. An adjustable actuator stop is associated with each conveyor deck for limiting the distance the leading portion of the web can advance along the deck, and conveyor means associated with each conveyor deck propels the flexible web therealong and into contact with the adjustable actuator stop. Counter-rotating elements positioned adjacent the front end of each conveyor deck in substantially longitudinal alignment with the top of the conveyor deck define a receiving slot to receive a preselected transverse segment of the flexible web along

which it is desired to fold the web. Fold-starting means are included for urging the desired pre-selected transverse segment into the receiving slot. The adjustable actuator stop is operatively associated with the fold-starting means for actuation thereof, whereby upon engagement of the leading portion with the adjustable actuator stop, the desired transverse segment is urged into the receiving slot for initiating folding.

A continuous conveyor belt snakes between the counter-rotating elements and is arranged for contact therewith to convey the newly folding web therealong, the conveyor belt acting conjointly with the counter-rotating elements to introduce a fold along a different pre-selected transverse segment of the flexible web at each receiving slot, whereby the flexible web may be folded into a plurality of segments of various sizes and configurations or various patterns, as may be desired by the operator.

Other objects, aspects and advantages of the present invention will be more fully understood from a consideration of the following detailed description in conjunction with the accompanying drawings, as follows:

FIG. **1** is a side elevational view, in partial section, showing a machine including the multi-level conveyor deck apparatus for folding large flexible webs, for example, large plastic bags such as law cuttings and leaf bags, trash bags, disposable garbage bags, and the like;

FIG. **2** is a partial plan view of the multi-level deck apparatus shown in FIG. **1**, with parts broken away;

FIG. **3** is an enlarged view of the counter-rotating elements shown in FIG. **1**;

FIG. **4** is a side view of a large flexible web havng a single fold introduced therein by apparatus embodying the present invention;

FIGS. **5** through **7** are side views of large flexible webs, such as large plastic bags, having double folds introduced therein by the apparatus and showing the various fold configurations which may be achieved by adjusting the adjustable actuator stops along the respective conveyor decks; and

FIGS. **8** through **10** are side views of large flexible webs, such as large plastic bags, having triple folds introduced therein by the apparatus and showing the various fold configurations which may be achieved by adjusting the adjustable actuator stops along the respective conveyor decks.

Referring to FIG. **1**, there is shown a web folding machine **10** which is well suited for folding large plastic bags. This machine **10** includes multi-level conveyor deck apparatus and is advantageous for use with a conventional web or bag making machine (not shown). The flexible web, as shown, is a large plastic bag **12** which has been fed into the machine **10** from a conventional bag making machine at the left in FIG. **1** (not shown) and has been received at the receiving station, generally indicated at **14**. A plurality of spaced parallel continuous conveyor belts **16, 16A, 16B, 16C, 16D** and **16E** (FIG. **2**) are snaked between the receiving station **14** and an exit station, generally indicated at **18** (FIG. **1**). The speed of the composite conveyor belt **16–16E** is adjusted to match the web output speed of the conventional bag making machine, through a variable speed drive **20.**

The large plastic bag **12** is conveyed along by the composite conveyor belt **16–16E** toward the first level or work station **21,** and it is placed in compressive contact with a first comb tray or plurality of stripper blades

24 and rotating idler wheels 26 as it is conveyed to the counter-rotating means 22. This counter-rotating means 22 includes a first unitary metal roller 28 of the same diameter as a plurality of individual rollers 30 having a face width of 1¾ inches and having ¾ inch spacers positioned between them, as seen in FIG. 2. These individual rollers 30 are all mounted on the same shaft 31 (FIGS. 1 and 3) and, in effect, they cooperate to provide a segmented second roll which is in the counter-rotating opposition to the first roll 28.

This first set of rollers 28 and 30 are spaced relative to one another to form a first receiving slot 32. The continuous conveyor belt 16 is snaked diagonally down through the receiving slot 32, passing over the first roller 28 and passing beneath the second roller 30, and maintaining tangential contact with both rollers 28 and 30.

Positioned adjacent the counter-rotating means 22 is a first metal, electrically conductive, conveyor deck 34 with its top surface 36 substantially tangentially aligned as shown in FIGS. 1 and 3, with but slightly lower than the level of the top portion 38 of the roller 30. The air-floatation conveyor deck 34 is pivotally mounted at 42 to the frame 40 of the machine 10, so as to be capable of swinging about pivot connection 42 for 90° movement from a substantially horizontal to a substantially vertical position, as indicated at 34' by a dash and dotted outline in FIG. 1.

The counter-rotating roller means 22 is positioned in a slightly elevated relationship relative to the front end 44 of the conveyor deck 34; further, the first roller 28 is slightly elevated relative to the second roller 30, e.g. the roller 28 being ¼ inch higher. This elevation aids in initially conveying the leading end 46 of the large plastic bag 12 across the receiving slot 32 (formed between the first roller 28 and second roller 30) and onto the top surface 36 of the air-floatation conveyor deck 34.

Means 48 for imparting supporting air impulses to the large plastic bag 12 as it moves and spans across the receiving slot 32 are positioned at the front end 44 of the conveyor deck 34. The impulse imparting means 48, shown as air jets, support the plastic bag 12 and prevent the leading edge 46 thereof from following the conveyor belt 16 down into the receiving slot 32. These air jets direct streams of air, between the segmented rollers 30, and the streams of air pass beneath the shaft 31 and then the streams are deflected by the snaked belt 16, so that the air flow curves upward through the receiving slot 32. The upward flow of air through the space 32 supports the bag 12.

Conveyor means, shown as alternate air slits 50 in the conveyor deck 34, provide air streams which angle upwardly to strike the lower surface of the large plastic bag 12 above the conveyor deck 34 providing a horizintal force component to the large plastic bag 12 to thereby convey the large plastic bag 12 by air floatation along the conveyor deck 34.

Positioned on the conveyor deck 34 is a ramp positioning means, shown as a metal strip 52 for lifting the leading end of the bag 12 into position to strike against the adjustable actuator stop means, shown as a microswitch 54. This microswitch is capable of being adjustably positioned along the strip 52. The large plastic bag 12 is moved along the conveyor deck 34 and along the metal strip 52 until the leading edge 46 strikes the adjustable actuator stop means 54.

As mentioned above, this adjustable actuator stop means 54 may be adjustably positioned anywhere along the metal strip 52. Its position is determined by considering the total length of the large plastic bag 12 and the desired relative location of the transverse segment of the bag as indicated at 56, at which it is desired to introduce a fold. When the actuator stop 54 is engaged by the leading end of the bag, the forward movement of the bag is momentarily stopped, and the switch 54 causes the transverse bag segment 56 to be urged down into the slot 32 by fold initiating means 58, shown as an air tube. A momentary blast of air down through a plurality of ports in the bottom of the horizontal air tube 58 drives the bag portion 56 down into the nip region between the belt 16 and the roller 30. The bag is thereby folded at 56, and is pulled down beneath the roller 30.

The folded bag segment 56, urged into the receiving slot 32, is nipped between the conveyor belt 16 extending diagonally therethrough and the second roller 30 acting conjointly therewith to compress the plastic bag 12 along the transverse segment 56 introducing a fold therealong. The remaining portions of the large plastic bag 12, on both sides of the folded transverse segment 56, are pulled down beneath the roller 30 to follow the transverse segment 56 which has now become the new leading edge.

It is noted that there is a short approximately horizontal belt section 63 after the belt 16 has curved down around the segmented roller 30 and before the belt 16 begins snaking down diagonally between the second set of counter-rotating rollers 68 and 70.

The singly folded bag 60 (FIG. 1) passes onto the second level or work station 61. This singly folded bag 60 is placed in stripping guiding contact with the second comb tray or plurality of stripper blades 62, as it passes above the second counter-rotating means 64 and onto the second air-floatation conveyor deck 66. The plurality of stripper blades 62 prevent the singly folded bag 60 from following up around the path of rotation of the second roller 30, which might otherwise cause the bag to jam up into the space between the roller 30 and the end 44 of the first deck 34.

The rollers 68 and 70 of the second counter-rotating means 64 are similar in construction and arrangement with the first and second rollers 28 and 30 respectively, of the first counter-rotating means 22. The second counter-rotating means 64 is also positioned relative to the second conveyor deck 66 in the same relationship as the first counter-rotating means 22 relative to the first conveyor deck 34. Further, the rollers 68 and 70 form a second receiving slot 72 with the conveyor belt 16 snaking diagonally down through the slot 72 in tangential contact with the top of roller 68 and the bottom of roller 70. The roller 68 is of unitary construction, and the roller 70 is of segmented construction, just like roller 30.

A second fold-initiation air tube 74 is associated with the second receiving slot 72. Also, second air jets 76 are positioned in the front end 78 of the second conveyor deck 66 for providing a flow of air beneath the roller shaft 71 upward through the slot 72 for temporarily supporting the bag as it spans across the slot 72. The second conveyor deck 66 also has a metal ramp leading end positioning strip 80 with adjustable actuator stop means 82 positioned thereon and has alternate air slits 83 arranged therein. This second level 61 per-

forms the same functions as the first level 21 and is capable of introducing a second fold in the plastic bag 12 along a desired transverse region 84.

The transverse segment 84, folded in the second receiving slot 72, thereby becomes the new leading edge 84 as the double-folded bag 85 is conveyed to the third level or work station 86. The same functions take place at the third level 86, which includes third counter-rotating means 88 and a third air-floatation conveyor deck 90, as have occurred at the two previous levels 21 and 61. Thus, the third level introduces a third transverse fold into the plastic bag 12.

Support tube 92 does not produce an air stream since the conveyor belt 16 conveys the tri-folded bag 12 from the third receiving slot 93 directly to exit station 18. There are stripper elements 62 supported by the fold-initiating tube 100 and also by the support 92. There are air jets 76 at the front end of the third deck 90 for supporting the bag spanned across the slot 93 between rollers 101 and 102. The exit station 18 is effectively down at a fourth level in the multi-level conveyor apparatus 11.

The three conveyor decks 34, 66 and 90 are arranged in a horizontal stacked spaced relationship relative to one another. The conveyor decks 66 and 90 are also pivotally mounted to the frame 40 of the apparatus 10, about respective pivot connections 94 and 96, in like manner as previously described with respect to the first conveyor deck 34. Such a multi-level stacked spaced arrangement with pivotally mounted conveyor decks facilitates easy access to lower levels should a plastic bag become jammed in the multi-level conveyor apparatus 11. These three conveyor decks may be readily swung 90° up to vertical, out-of-the-way positions 34', 60' and 90' (see FIG. 1) for clearing a jam or for adjusting the position of the respective adjustable actuator stop means 82 and 84 along the positioning strips 80 on lower levels.

Additionally, as shown in FIG. 1, the conveyor decks 34, 66 and 90 are hollow chambers with air supply conduits through the pivotally hinged joints 42, 94 and 96, respectively. These pivot connection conduits 49, 94 and 96 communicate with a pressurized air source, for example, a duct system 99 supplied by a motor driven blower 59. Alternatively, the frame 40 may be arranged to define a pressurized air supply plenum chamber to which the connections 49, 94 and 96 are joined. Then the blower 59 supplies the plenum chamber.

Referring specifically to FIG. 3 of the drawings, there is level by-passing means 98 for preventing transmission of the leading edge of the plastic bag 12 to the individual conveyor decks. This by-pass means 98 may be employed to introduce a lesser number of folds (than three) in the plastic bag 12. The by-pass means, shown in dotted outline in FIG. 3, is a removable baffle 98 conveniently hung upon and extending downwardly from the second fold-initiating air tube 74.

The removable baffle 98 may also be readily hung from the first air tube 58 or from the third air tube 100. Further, if desired, two baffles 98 may be employed to produce only a single fold in the plastic bag 12. Access to the air tubes 74 and 100, associated with the second and third levels 61 and 86, respectively, for mounting the by-pass baffle or baffles 98, may be readily obtained by swinging the upper conveyor decks upward to their vertical positions as shown in FIG. 1.

The by-pass baffle 98 will direct the leading end of the plastic bag directly into the respective receiving slot associated therewtih, preventing the leading end from entering the particular deck level and consequently preventing a fold from being introduced in the plastic bag 12 at that respective level.

In many plastic web handling machines there is a problem due to build up of static electricity on the web. Such static electricity causes the web to "cling" and become difficult to handle. Elaborate high voltage discharge devides are often required to be employed in the prior art.

The plastic bag 12 in contact with the conveyor belt 16, normally has a tendency to become charged up with static electricity. The metal conveyor decks 34, 66 and 90 and also the second segmented metal rollers 30, 70 and 102 of the counter-rotating means 22, 64 and 88, respectively, with which the plastic bag 12 comes in contact, serve as conductors for the discharge of any static electricity. Thus, the build up of static electricity is advantageously avoided without requiring any elaborate discharge devices.

It should be appreciated that this multi-level conveyor apparatus 11 for folding large plastic bags 12 can adjust to any bag length over a large range and to fold a bag into any desired length segments by adjusting the positions of the adjustable actuator stop means 54, 82 and 84. Additionally, the number of folds can be increased by increasing the number of levels. Further, the number of folds can be readily reduced by employing one or more by-passing baffle means 98.

Particularly, with reference to FIGS. 4 through 10, the versatility of the apparatus 10 in providing different fold configurations or arrangements of folds is apparent. If it is desired to introduce only one fold, as shown in FIG. 4, baffles 98 may be utilized to by-pass two of the three conveyor decks. As shown in FIGS. 5 through 7, if it is desired to produce two folds, a single by-pass baffle 98 is used to direct the leading edge emerging from the preceding set of rollers directly to the next receiving slot without introducing a fold in the plastic bag.

Further, the differnet two-fold configurations shown in FIGS. 5 through 7 may be produced by varying the respective positions of the adjustable actuator stop means along the two conveyor decks which are being utilized.

FIGS. 8 through 10 show the different three-fold configurations that may be obtained when utilizing all three conveyor decks and varying the respective positions of the adjustable actuator stop means 54, 82 and 84 along the three conveyor decks.

The air slits or outlets 50, 83 and 85 in the respective conveyor decks are alternately arranged (or staggered) in successive lines (or rows) as seen in FIG. 2. These outlets are formed by depressing the downstream lips of the slits to create an upwardly inclined and downstream directed nozzle action.

It should be fully understood that various modifications may be made in the embodiments of the present invention without departing from the spirit or scope thereof as described in the specification and defined in the appended claims.

What is claimed is:

1. A multi-level apparatus for folding large flexible webs, for example, such as large plastic bags, adapted to fold the individual flexible webs into multiple seg-

ments, the number of folds capable of being made corresponding to the number of levels in the apparatus, said apparatus comprising:

a plurality of conveyor decks arranged in a vertically spaced stacked relationship relative to one another defining a number of levels equal to the number of said decks;

each of said decks having a front end and being adapted for receiving a leading portion of the individual flexible webs to be folded;

adjustable actuator stop means associated with each of said conveyor decks and being spaced from the front end of the respective decks for limiting the distance the leading portion of the individual webs can advance from the front end along each of said conveyor decks;

means for conveying the individual webs along each of said conveyor decks so that their leading portions will contact said adjustable actuator stop means associated therewith;

counter-rotating means positioned adjacent the front end of each of said conveyor decks and in substantially tangential alingment therewith, each of said counter-rotating means including counter-rotating rolls and a receiving slot for receiving a transverse segment of the web along which it is desired to introduce a fold;

means associated with each of said receiving slots for urging the desired transverse segment of the individual webs into said respective receiving slots, said urging means being actuated when the leading web portions engage said adjustable actuator stop means associated with the adjacent conveyor deck, whereby the desired transverse segment of the web along which a fold is to be introduced is urged into said receiving slot;

a conveyor belt extending between said counter-rotating means and in contact therewith to convey the flexible web therealong and acting conjointly with said counter-rotating means to fold the transverse segment of the flexible web which is urged into each of said receiving slots at the various levels; and

said plurality of stacked conveyor decks being pivotally connected to said apparatus for movement to an out of the way position to allow ready access to said adjustable actuator stop means positioned on the respective lower conveyor decks for adjusting the position of said adjustable actuator stop means and to allow ready access to the respective adjacent counter-rotating means should a flexible web be jammed therein,

whereby the individual flexible webs are folded into a multiplicity of segments for ease in handling and storage.

2. A multi-level apparatus for folding large flexible webs as claimed in claim **1**, in which:

each of said conveyor decks is hollow forming an air chamber therein,

a pressurized air source communicates with the chamber in each of said decks, and each of said conveyor decks having a plurality of openings therein directed upwardly at an angle away from the front end of the deck for conveying the plastic web by air floatation away from the front end toward the actuator stop means associated therewith.

* * * * *