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(54) **TISSUE PACKAGING APPARATUS**

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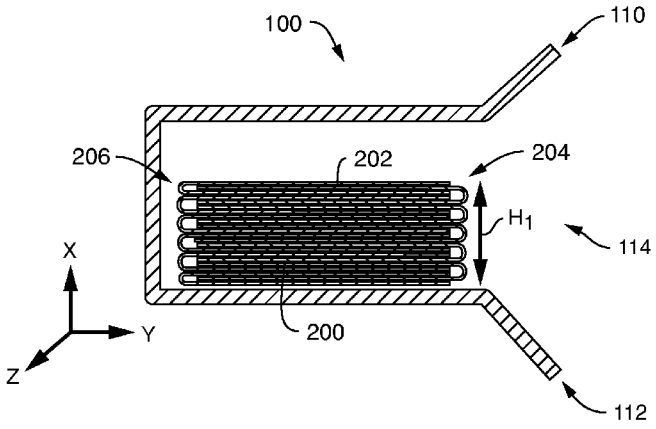
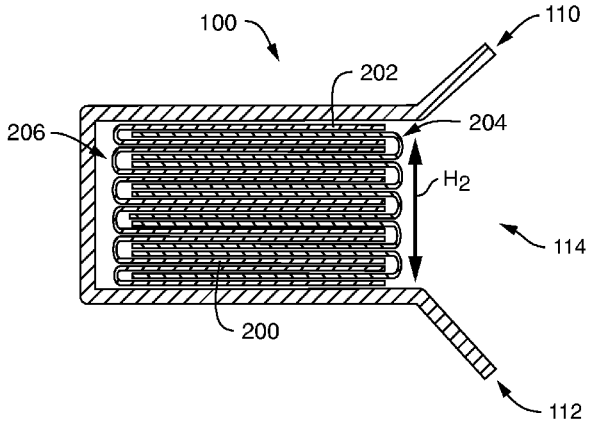
(57) **ABSTRACT**

The present invention provides an apparatus and method for controlling the height of a clip of sheet material that is independent from the other steps of the manufacturing, converting and packaging operations. The invention comprises introducing positive pressure air flow after the clip has been at least partially inserted into a carton. Positive pressure air flow is provided in a direction substantially parallel to the longitudinal axis of the clip and transverse to the cut end of the sheet causing the clip to increase in height. The degree of increase may be controlled by controlling the positive air pressure, while the carton acts as a restraint for the clip.





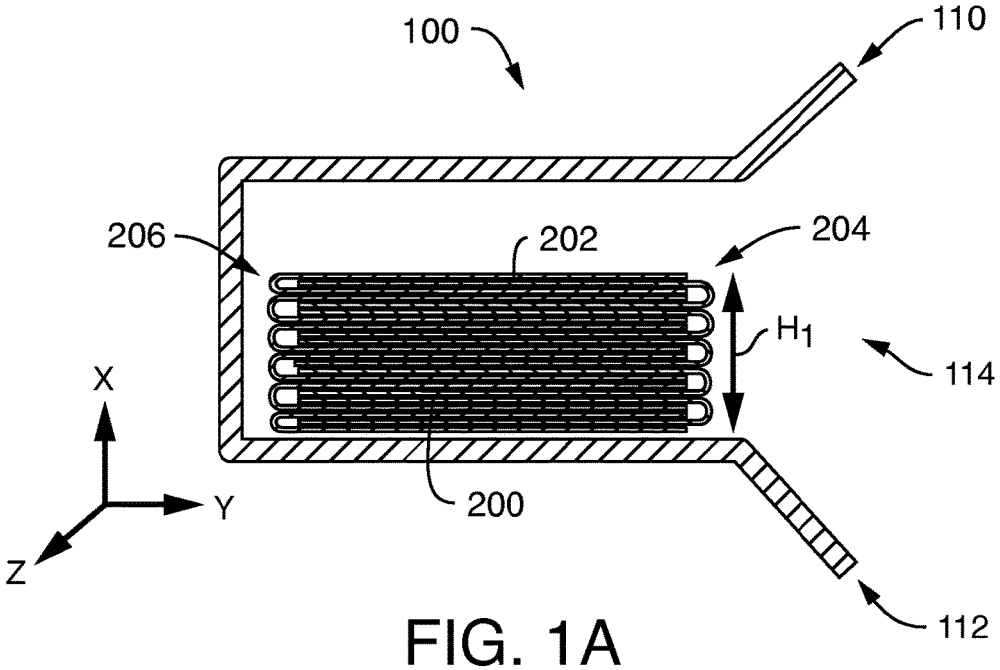
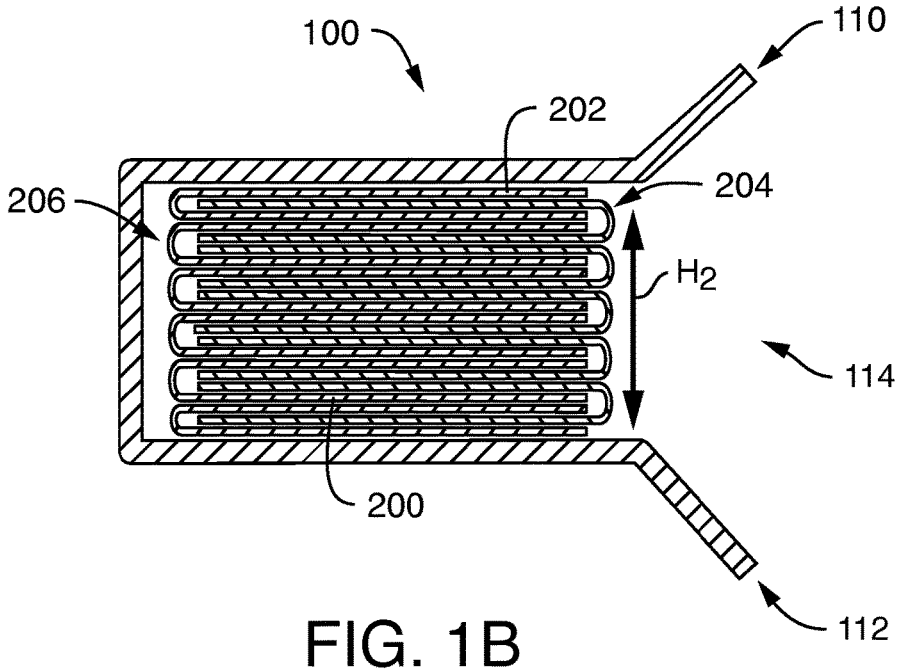

100
110
206
202
204
H_1
114
X
Y
Z
200
112

FIG. 1A


100
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H_2
114
200
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FIG. 1B

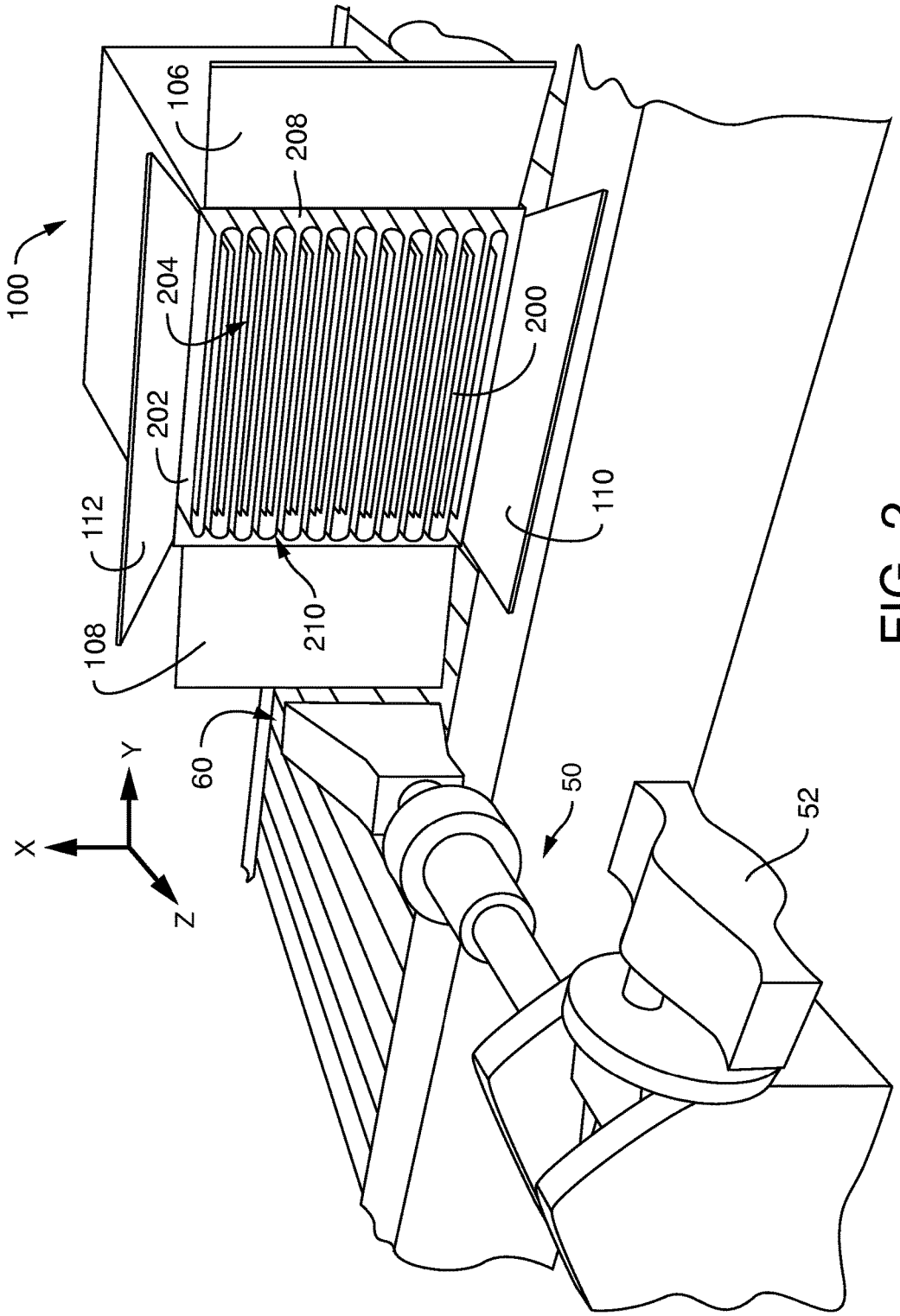

FIG. 2

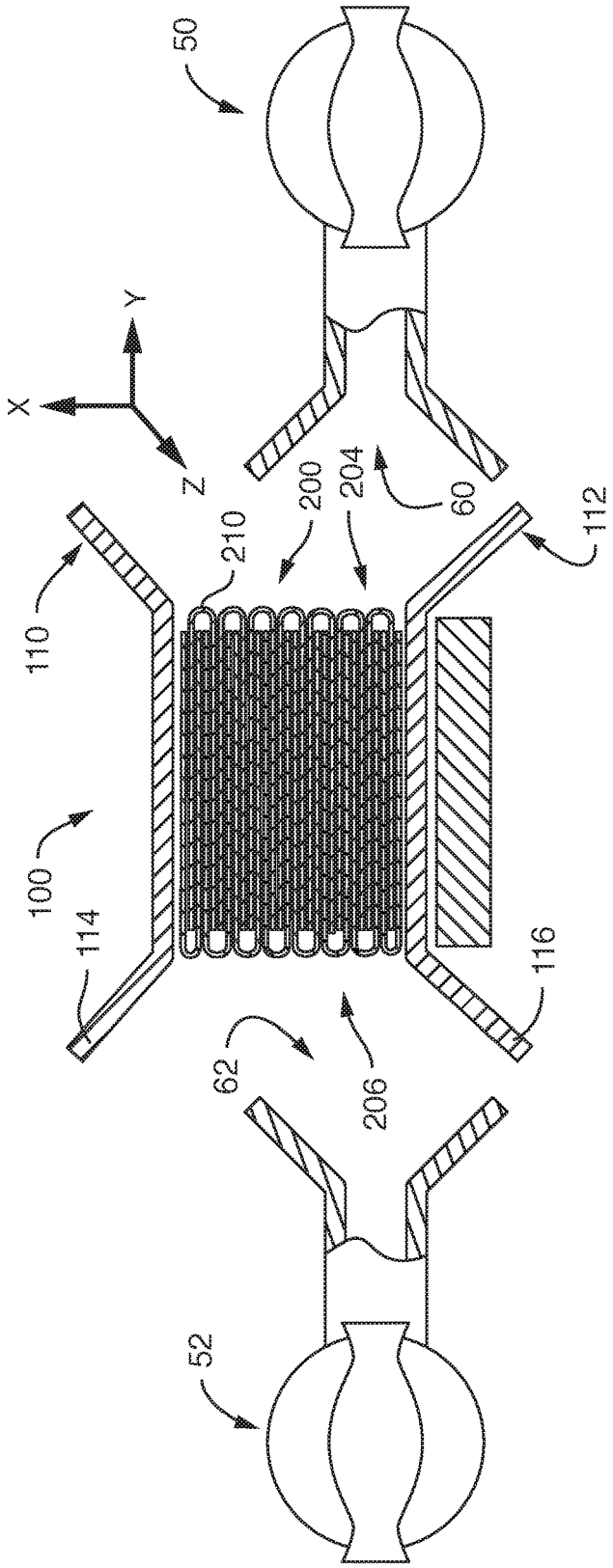

FIG. 3

TISSUE PACKAGING APPARATUS

BACKGROUND OF THE DISCLOSURE

[0001] Sheet materials, such as tissue paper, are often interfolded into stacks or clips and then placed into a carton such that upon removal of one sheet, a subsequent sheet is partially dispensed having an exposed portion that extends from the carton's opening. This method of "pop-up" sheet dispensing is convenient for many applications, since the next sheet is readily presented for quick access.

[0002] The height of a folded stack of sheet material in relation to the carton height, often referred to as clip height, is often the user's first interaction with the product and may affect the user's perception of value and affect dispensing of the first sheet. Clip height, however, is difficult to control during the manufacture, converting and packaging of the folded clip. Factors such as basis weight, sheet caliper, sheet dimension, sheet count and processing compression all impact clip height. These factors are a mix of product design and processing conditions and may be variable in the manufacturing process causing variation in the ultimate product appearance and performance. If clip height is too low the consumer may perceive this as a poor value. A low clip height may also negatively affect dispensing by causing the user to reach into the carton to grasp the first sheet. Conversely, if clip height is too great the clip may be compressed in the carton and the first sheet may be difficult to dispense or may tear upon dispensing. This too is unsatisfactory.

[0003] Thus, what is needed is a means of decoupling clip height from all of the manufacturing, converting and packaging processes to provide consistent, predictable and controllable clip height. Such a means would improve product performance and perception of value while improving production costs.

SUMMARY OF THE DISCLOSURE

[0004] The present inventors have discovered an elegant, relatively simple, means of controlling clip height that is independent from the other steps of the manufacturing, converting and packaging operations. By introducing positive pressure air flow after the clip has been at least partially inserted into the carton the inventors have discovered a means to control clip height. Positive pressure air flow is provided in a direction substantially parallel to the longitudinal axis of the clip and transverse to the cut end of the sheet causing the clip to increase in height. The degree of increase may be controlled by controlling the positive air pressure, while the carton acts as a restraint for the clip.

[0005] Thus, in one embodiment, the present invention provides a method of packaging a clip of tissue comprising the steps of providing a carton, providing clip comprising interfolded sheet material, the clip having a longitudinal central axis passing through a first and a second end, at least partially inserting the clip into the carton, conveying the carton containing the tissue clip and applying a positive air pressure substantially perpendicular to the direction of conveyance thereby forming an air flow toward the clip of individually folded sheets.

[0006] In other embodiments the invention provides a clip comprising interfolded sheet material, the clip having a longitudinal central axis passing through a first and a second end and a means for providing air flow substantially parallel to the longitudinal central axis of the sheet material, the air flow causing at least a portion of the individual sheets to at least partially separate from one another. In a particularly preferred embodiment the at least partial separation of at least a portion of the individual sheets causes the clip height to increase from a first height (h**1**) to a second height (h**2**), where h**2** is at least about 10 percent greater than h**1**.

[0007] In yet other embodiments the invention provides a means for separating and arranging the sheets in the top third of a clip of folded sheet material such that the top sheet is disposed adjacent to the top of a carton and easily accessed by a user in-use.

[0008] In other embodiments the invention provides a method comprising the steps of placing a clip of individually folded tissue sheets into a bucket, the clip having a longitudinal central axis passing through a first and a second end; advancing the clip towards a container by a pusher assembly contacting either the first or the second end of the clip, the pusher assembly moving in a direction parallel to the longitudinal central axis of the clip; and applying air flow substantially parallel to the longitudinal central axis of the clip whereby at least a portion of the individually folded tissue sheets are separated from one another.

[0009] In still other embodiments the invention resides in an apparatus comprising a bucket having an open pusher end, an open container end, and a floor; a pusher assembly having a pusher head and configured for back and forth motion within at least a portion of the bucket, a positive pressure air jet and a means for conveying a carton from the bucket to the positive pressure air jet.

BRIEF DESCRIPTION OF DRAWINGS

[0010] FIG. **1**A illustrates a cross section view of a tissue carton and clip prior to the height of the clip being increased;

[0011] FIG. **1**B illustrates a cross section view of a tissue carton and clip after the height of the clip has been increased;

[0012] FIG. **2** illustrates a perspective view of a tissue packaging apparatus according to one embodiment of the present disclosure; and

[0013] FIG. **3** illustrates a cross section view of a tissue packaging apparatus according to another embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0014] Generally the present invention is useful in the handling and packaging of packaged sheet material such as folded tissue paper products. Packaged sheet material, particularly folded tissue paper products, are provided in the form of stacks of individual sheet material. Each stack may comprise from about 10 to about 200 sheets, such as from about 50 to about 180 sheets and more preferably from about 100 to about 150 sheets. These stacks of sheet material are commonly referred to as clips and are loaded into cartons for dispensing by an end user.

[0015] The stack of sheet material, such as sheets of tissue paper, may be interfolded, prefolded interfolded, or non-interfolded. As used herein, the phrase "prefolded interfolded" or "interfolded" tissues means that the tissues are folded and interleaved with neighboring tissues immediately above and/or below in the clip of tissues. The tissues can be interleaved by any suitable means, including the use of an

interfolder as employed in the papermaking arts. If an interfolder is used, consecutive tissues may be attached to each other at perforation lines. In such cases, the unperforated segments of the perforation lines should be sufficiently weak to permit the consecutive tissues to separate from each other upon removal from the carton. This can be controlled by the degree of perforation of the tissue sheet. Tissues that may be employed in a non-interfolded clip which are not interleaved with neighboring tissues are releasably attached to neighboring tissues so that upon dispensing one tissue, the next adjacent tissue is ready for dispensing. Particularly preferred folding patterns include interfolding patterns that provide somewhat less friction, which tend to avoid tearing of the tissue when extracted from the container.

[0016] With reference to FIG. **1**A a clip **200** of sheet material **202** is illustrated. The clip **200** comprises a specific number of individual sheets **202**. If desired, the sheets can be folded prior to stacking them to form the clip. Alternatively, individual non-folded sheets could be stacked to form the clip. The sheets within the clip can be either interfolded for pop-up dispensing, joined together by weakened lines such as perforations for pop-up dispensing, or individually folded for reach in dispensing. The clip has a first **204** and a second **206** opposing end and a first **208** and a second **210** opposing side (illustrated in FIG. **2**). In certain embodiments the first and second ends may be cut ends, as described in more detail below.

[0017] With further reference to FIG. **1**A, the clip has a longitudinal central axis orientated about the z-axis and passing through the first **208** and a second end **210**. The clip also has a center line extending from the bottom sheet to the top sheet of the clip along the x-axis and bisecting the first and second ends of the clip. Generally the height of the clip (h) is measured along this center line. The sides of the clip are longer than the depth or width of the ends. Typically, a free end of the sheet material is positioned near the center of the clip and aligned with the longitudinal central axis. This helps to position the first sheet of the clip beneath a dispensing opening after the clip is placed into a carton.

[0018] It must be noted that while the general shape of the carton **100** can be rectangular as shown; other shapes can also be employed, such as hexagonal, triangular, square, and the like. Accordingly, the top and bottom sidewalls of the carton can be any shape or size. Suitable shapes can include triangular, square, rectangular, pentagon, hexagon, octagon, oval, circular, star shaped or fluted. The overall size of the carton and the shape of the sidewalls can be designed as needed to properly dispense the sheet material placed within the carton. The size and shape of the carton can be influenced by the size of the sheet material being dispensed, how the sheets are folded prior to placement in the carton, the number of sheets placed into the carton, the orientation of the stack, configuration of the stack within the carton, and the characteristics of the material being dispensed. Often more than one acceptable shape will work to properly dispense the sheet material.

[0019] Stacks **200** of individual paper sheets **202** are often loaded into cartons **100** for dispensing by a user. Cartons are well known in the art and may, for example, comprise opposed top and bottom panels, opposed first and second side panels and opposed front and end panels. The carton may be produced from the blank comprising a pair of side panels bent at right angles along fold lines so as to extend upwardly from the bottom panel and then the end panels are formed from two pairs of opposed end flaps **106**, **108**, **110** and **112**. The end flaps **106**, **108**, **110** and **112** are folded inwardly in a consecutive manner about fold lines so as to partially overlap. The flaps are then secured together to form the end closure of the carton.

[0020] Clips may be loaded into cartons using a cartoning mechanism. Cartoning mechanisms wherein the clip is inserted into a carton, such as a folded paperboard carton having a first open end, are well known in the art and cartoning mechanisms useful in the present invention may vary. In one embodiment the cartoning mechanism comprises a conveyor transporting longitudinally-spaced clips and a means for rotating the clips approximately 90 degrees to dispose them in spaced, side-by-side relation. The spaced apart clips may then be disposed in bundle-receiving buckets or holders of an infeed conveyor of the cartoning mechanism and then loaded into cartons.

[0021] Generally the cartoning mechanism is coupled, such as a by a conveyor, with a continuous folder or interfolder, or the like, wherein a plurality of paper webs are arranged in superposed relation to develop the stacks of tissue to be packaged into cartons by a cartoning mechanism. A transfer conveyor is provided which in turn leads to a severing conveyor. Positioned above the conveyor are a plurality of rotary disc knives that sever the continuous web stack into a plurality of discrete clips. As the clips leave the severing conveyor, they ultimately pass to a speed-up conveyor wherein a prescribed center-to-center distance is achieved.

[0022] Ultimately individual clips are rotated 90 degrees relative to the orientation of the continuous log from which they were derived. The clips may be reoriented using a paddle mechanism operative to sweep the bundles through an arc so as to dispose the clips at an orientation of about 90 degrees relative to the orientation of the continuous log from which they were derived. Once the clips have been reoriented they may be deposited in a holder or bucket.

[0023] The bucket is generally designed to guide the clip into the carton. The bucket may have two upstanding walls and a floor such that the bucket has an open top and open opposing ends. The bucket may have a funnel shape such that the bucket tapers from an open pusher end to an open carton end for assistance in guiding the clip into the carton, or the bucket may have parallel upstanding walls. The open pusher end may further comprise a radius or lip for assistance in guiding the clip into the bucket. The size or shape of the bucket can be varied depending on the clip's configuration such as the clip's sheet count, type of sheet material contained by the clip, whether the clip is wet or dry, and the overall size of the clip (length, width, and height). The bucket acts to guide the clip first into the bucket and then into the carton as the clip is advanced through the bucket into the carton.

[0024] A pusher assembly configured for back and forth motion is disposed adjacent the pusher end of the bucket. The pusher assembly includes at least a pusher head. The pusher assembly is used to advance the clip along the bucket and into the carton.

[0025] In certain embodiments multiple buckets can be attached to a bucket conveyer, multiple cartons can be conveyed by a carton conveyer with multiple carton lugs and multiple pusher assemblies can be actuated to various extended positions for simultaneous filling of multiple cartons as the cartons and buckets are advanced in relation to

one another by the respective conveyors. Typically, the bucket and carton conveyors form an endless loop having a linear horizontal portion for loading clips into the cartons.

[0026] Upstream of the clip loading apparatus a carton **100** with a first open end **114**, which may be defined by four open flaps **106**, **108**, **110**, **112**, is loaded onto the carton conveyer by an upstream carton feeding and erecting apparatus. The carton, bucket, and pusher assemblies are advanced along their respective paths within the cartoner until the pusher head contacts the first end **204** of the clip **200**.

[0027] The clip loading sequence is completed as the pusher assembly advances the clip into the carton. The carton, bucket, and pusher assembly continue to advance along their respective paths as the pusher assembly is retracted out of the carton. The bucket conveyor and the carton conveyor diverge to enable the closing of the flaps **106**, **108**, **110**, **112** of the carton **100** to be folded and glued shut after which the carton is removed from the carton conveyer. The bucket continues around the bucket conveyor and returns to its initial point and a fresh clip is loaded into the bucket to start a new cycle.

[0028] Once the clip is at least partially loaded into the carton and before the end flaps are folded and sealed, the clip and carton are advanced, such as by a conveyor to a positive pressure air device. The positive pressure air device applies a pressure differentially across the longitudinal axis of the clip causing the clip height to increase from a first height (h**1**) to a second height (h**2**). Generally the height of the clip may be measured from the bottom surface of the lower most sheet in the stack to the top surface of the upper most sheet in the stack when the clip is in an uncompressed state. The increase in clip height is generally achieved by at least a portion of the individual sheets being separated from one another. The number of sheets separated and the degree of separation may be controlled by various factors such as the degree of positive air pressure, the number of individual sheets in the clip, the folding pattern, the amount of pressure applied to compress the clip prior to loading into the carton and the degree of sheet-to-sheet adhesion.

[0029] With reference to the figures, prior to being subjected to positive air pressure the clip has a first height (h**1**), as illustrated in FIG. **1**A. After the clip has been subjected to positive air pressure as described herein, the clip has a second height (h**2**), as illustrated in FIG. **1**B. Preferably the conditions are such that the increase in height (the difference between the first height (h**1**) to the second height (h**2**)) is at least about 5 percent, more preferably at least about 10 percent and still more preferably at least about 15 percent, such as from about 15 to about 50 percent. The positive pressure air device may be positioned so as to increase the height of the bottom third of the clip, the top third of the clip, or increase the height of the entire clip.

[0030] Increasing the height of the clip relative to the height of the carton improves the fill ratio and may improve a user's perception of value and improve dispensing of the sheet material. The Fill Ratio is calculated by first calculating the clip's volume (height×width×length). For this calculation, the carton is opened and the height of the clip is measured. The clip is then removed and the length of the clip is determined. Preferably the dimensions of the clip are measured from at least five different cartons of similar tissue product and the values averaged to determine the clip volume. Next, the interior volume of the carton is calculated by measuring the interior width, depth, and height of the carton (width×depth×height). To determine the Fill Ratio as a percentage, the clip's volume is divided by the carton's interior volume and multiplied by 100.

[0031] Preferably the Fill Ratio of cartons manufactured according to the present invention is greater than about 80 percent, more preferably greater than about 85 percent and still more preferably greater than about 90 percent, and still more preferably greater than about 95 percent. Compared to tissue cartons manufactured by conventional means the fill ratio is at least 5 percent greater and more preferably at least about 10 percent greater.

[0032] With reference to FIG. **2** a carton **100** comprising a clip **200** of individually folded tissues **202** being conveyed along a conveyor is shown. The first end **114** of the carton **100** is open and exposes the first end **204** of the clip, which has been inserted into the carton **100**. The open carton **100** containing the clip **200** is conveyed by a conveying means to the air jet device **50**. The positive air flow from the air jet device **50** is generally aligned with the transverse central axis of the clip so as to provide air flow across the length of the clip and cause individual sheets to become separated from one-another.

[0033] The positive pressure air jet device **50** comprises a nozzle assembly **60** which is positioned adjacent to the first end **204** of the clip **200** as it is conveyed past the air jet device **50**. As noted above, the air jet device **50** is for the purpose of levitating at least a portion of the individual sheets **202** in the clip **200** and increase the overall height (h) of the clip **200**.

[0034] Useful means of providing a positive pressure air flow across the clip are well known in the art. In one embodiment the positive pressure air jet device **50** includes a first air jet arrangement **52** and incorporates a single nozzle **60** in flow communication with a source of positive pressure air. The nozzle may be orientated in several different directions relative to the clip. In the illustrated embodiment the nozzle **60** is aligned substantially along the center line of the clip. The single nozzle **60** directs a high pressure air stream at the clip causing individual sheets to be separated from one another the height of the clip to be increased. In certain preferred embodiments the air stream is aimed at upper third of the clip to fluff the top several sheets in the stack to bring the topmost sheet into contact with the upper wall of the carton where it can be more easily accessed and dispensed by a user.

[0035] In certain preferred embodiments the cross-sectional area of the nozzle **60** of the air jet arrangement **50** is shaped as a tear drop. The top portion of the tear drop is approximately half the dimension of the bottom portion so as to apply a larger amount of air at the bottom of the nozzle than at the top. In the preferred embodiment, the nozzle **50** is from about 1.0 to about 5.0 inches and more preferably from about 2.0 to about 3.0 inches (in the vertical dimension) across the bottom portion of the tear drop and between 1.0 to about 2.0 inches across the top portion of the tear drop. The location of the nozzle **60** to the front end **204** of the clip **200** is generally from about 0.5 to about 5.0 inches.

[0036] With the nozzle **60** configured in the above described manner, the top several sheets in the clip begin separation between each sheet and the topmost sheets rise along their center line to a controlled height. The positive air flow through the nozzle can be pulsed from a low to a high flow rate, or may be left on at a high flow rate. Again, referring to the preferred embodiment, the air flow is in the

range of between 1.0 and 10.0 cubic feet per minute. It has been found that air volume, velocity, and sheet weight can all vary within the described limits and still provide a consistent and controlled height to the elevated clip. Once the sheets have started to separate from one another the topmost sheet will rise towards the top most portion of the carton. The air flow going into the stack will ideally be allowed to proceed through the stack out the rear thereof, with some finding its way out through the sides of the stack.

[0037] Of course, employing the described parameters for the air jet arrangement modifications to such air jet arrangement may be envisioned as suitable for use in the fluffing and handling of clips according to this invention. For example, two converging positive pressure air jets may be employed. Further, the nozzle may have a square, rectangular, round or oval cross-section.

[0038] In other embodiments the nozzle may be integrally formed with the pusher assembly, noted previous, to both load and expand the clip using a single operation. In the foregoing embodiment the pusher arm advances, pushing the clip into the carton and then air flow is initiated to increase the height of the clip. The pulse of positive pressure air may be sequenced such that it is applied while the pusher arm is in contact with the clip or immediately after the pusher arm has placed the clip in the carton and has retracted.

[0039] In another embodiment, such as that illustrated in FIG. **3**, a pair of air jets **50**, **52** having opposed nozzles **60**, **62** in common flow communication with the source of positive pressure air (or, alternatively, a second separate source of pressurized air) are positioned on either end of the clip. The nozzles **60**, **62** may be positioned and arranged in a variety of configurations and orientations relative to one-another and the clip so as to maximize the increase in clip height or other clip height properties, such as disposing the top most sheet adjacent to the top of the carton. In one embodiment, the first air jet **50** is aimed so as to position the upper most sheet adjacent to the top of the carton and the second air jet **52** is positioned slightly downstream of the aim point for the first air jet nozzle and aimed towards the bottom third of the clip. In other embodiments the first and second air jets may be aimed at similar portions of the clip, but opposing one another.

[0040] After the air jets, the apparatus may comprise a sensor, such as an optical sensor, for detecting and measuring the height of the clip. The sensor may be integrated into a control scheme for controlling air pressure levels for optimum operation of the clip height control system. For example, a signal generated by the sensor may be communicated to the air jet, the pressure of which may be adaptively adjusted based on the measured clip height. More particularly, the measured clip height may be compared with a reference clip height and the air pressure may be adaptively adjusted based on the comparison to reduce or increase the clip height as necessary. Thus, a substantially constant clip height may be maintained using a closed loop control system.

What is claimed is:

1. A method of producing a carton of sheet material comprising the steps of: providing a clip of individual sheet material, the clip having a longitudinal central axis passing through a first and a second end; providing a carton; advancing the clip towards the carton by a pusher assembly contacting either the first or the second end of the clip to at least partially dispose the clip in the carton; conveying the at least partially filled carton; and applying positive air pressure across the clip in a direction substantially parallel to its longitudinal central axis.

2. The method of claim **1** wherein the clip has an initial height (h**1**) when at least partially disposed in the carton and a second height (h**2**) after the step of applying positive air pressure wherein h**2** is greater than h**1**.

3. The method claim **1** wherein h**2** is at least about 10 percent greater than h**1**.

4. The method of claim **1** further comprising the step of measuring the clip height after the step of applying positive air pressure.

5. The method of claim **4** further comprising the steps of generating a signal based upon the clip height measurement, communicating the signal to the air jet and adjusting the air jet positive pressure based upon the signal.

6. The method of claim **1** wherein the clip is entirely disposed within the carton and the carton has a Fill Ratio greater than about 90 percent.

7. The method of claim **1** wherein the carton comprises a first and a second end formed from a plurality of end flaps and further comprising the steps of sealing the first end flaps to form a first closed end and sealing the second end flaps to form a second closed end.

8. The method of claim **1** wherein the individual sheet materials are interfolded facial tissue sheets.

9. An apparatus for packaging a clip of sheet material comprising: a bucket for receiving a clip of individual sheet material, the clip having a longitudinal central axis passing through a first and a second end; a pusher arm assembly for urging the clip into a carton to at least partially fill the carton; a conveying means for conveying the at least partially filled carton; and a first positive air supply means for directing a flow of air at the clip.

10. The apparatus of claim **9** wherein the first air supply means comprises a source of pressurized air and a nozzle in flow communication with the pressurized air source of the first air supply means.

11. The apparatus of claim **9** wherein the nozzle is located in a plane substantially coincident with the center of the clip measured in a direction transverse to direction of conveyance.

12. The apparatus of claim **9** wherein the first positive air supply means comprises a source of pressurized air and a nozzle in flow communication with the pressurized air source of the first air supply means, the nozzle integrated with the pusher arm.

13. The apparatus of claim **9** further comprising a second positive air supply means for directing a flow of air at the clip, the second air supply means including a source of pressurized air and a nozzle in flow communication with the pressurized air source means.

14. The apparatus of claim **10** wherein the pressurized air source of the first air supply means is selected to provide a stream of pressurized air of sufficient flow to travel through the clip and exit at the second end of the clip in a direction transverse to the direction of conveyance.

15. The apparatus of claim **10** wherein the nozzle of the first air supply means is of a cross-sectional shape substantially approximating a tear drop, an oval, a square, a circle or a rectangle.

16. A method of producing a carton of sheet material comprising the steps of placing a clip of individually folded

tissue sheets into a bucket, the clip having a longitudinal central axis passing through a first and a second end; advancing the clip towards a container by a pusher assembly contacting either the first or the second end of the clip, the pusher assembly moving in a direction parallel to the longitudinal central axis of the clip and thereby at least partially disposing the clip in the carton; and applying air flow substantially parallel to the longitudinal central axis of the clip whereby at least a portion of the individually folded tissue sheets are separated from one another.

17. The method of claim **16** wherein the clip has an initial height (h**1**) when at least partially disposed in the carton and a second height (h**2**) after the step of applying air flow wherein h**2** is greater than h**1**.

18. The method claim **17** wherein h**2** is at least about 10 percent greater than h**1**.

19. The method of claim **16** further comprising the steps of measuring the clip height after the step of applying positive air pressure, generating a signal based upon the clip height measurement, adjusting the air flow based upon the signal.

20. The method of claim **16** wherein the clip is entirely disposed within the carton and the carton has a Fill Ratio greater than about 90 percent.

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