

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 765 220 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

16.01.2002 Bulletin 2002/03

(21) Application number: **94923243.3**

(22) Date of filing: **24.06.1994**

(51) Int Cl.7: **B32B 31/00, B31D 3/02**

(86) International application number:
PCT/US94/07150

(87) International publication number:
WO 96/00150 (04.01.1996 Gazette 1996/02)

(54) **MACHINE FOR MAKING HONEYCOMB MATERIAL**

MASCHINE ZUM HERSTELLEN VON WABENMATERIAL

MACHINE DE PRODUCTION DE MATERIAU EN NID D'ABEILLES

(84) Designated Contracting States:
**AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL
PT SE**

(43) Date of publication of application:
02.04.1997 Bulletin 1997/14

(73) Proprietor: **Pactiv Corporation**
Lake Forest, IL 60045 (US)

(72) Inventors:
• **Carder, Reuben C.**
Michigan City, IN 46360 (US)
• **Royster, William V.**
deceased (US)

(74) Representative:
**Grünecker, Kinkeldey, Stockmair &
Schwanhäusser Anwaltssozietät
Maximilianstrasse 58
80538 München (DE)**

(56) References cited:

US-A- 3 035 952	US-A- 3 257 253
US-A- 3 416 983	US-A- 3 637 448
US-A- 3 741 840	US-A- 3 770 549
US-A- 3 979 252	US-A- 4 133 712
US-A- 5 062 919	

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 765 220 B1

Description

Technical Field

[0001] This invention relates generally to a machine for making honeycomb material and, more particularly, to a machine which allows for the continuous and uninterrupted production of a continuous web of honeycomb material.

Background of the Invention

[0002] Honeycomb material has been conventionally produced with either a "Pad" machine or an intermittent-feed CHS (Continuous Hobe Splicing) machine.

[0003] Two types of "Pad" machines have been used, i.e., a "Padder" machine and a "Booth" machine. With the "Booth" machine, the honeycomb material is formed by feeding a single sheet of paper, unwound from a single roll of paper, horizontally towards a knife which cuts the sheet of paper longitudinally along its width into a plurality of longitudinally and horizontally disposed strips of paper. When a strip is cut, it is turned so as to be positioned vertically and then glued to the immediately preceding cut strip. The plurality of vertically positioned strips are then glued together to form the honeycomb material which is then cut to its desired length. A disadvantage associated with the "Booth" machine is that it uses only a single sheet of paper and produces core material at an extremely inefficient production speed of approximately 200 cuts per minute.

[0004] The "Padder" machine involves a three step process, performed by three separate machines, which includes the steps of forming pads of core material, sheering off slices from the pad of core material, turning the slices of core material on their sides so as to be positioned vertically and, finally, bonding the slices of core material to produce a continuous web of core material. A disadvantage of the "Padder" machine is that an operator is required for each of the machines and steps in the process. As a result of the process being multi-stepped, core material is produced at an extremely costly and inefficient production rate. Another disadvantage is that, as a result of having to bond slices of core material together to form the continuous web of core material, the resulting web includes a plurality of solid web lines thereby reducing the structural integrity of the web.

[0005] Three types of intermittent-feed CHS machines have been used, i.e., a "rotary" intermittent-feed CHS machine, a "cutter-stacker" intermittent-feed CHS machine, and a "horizontal blade" intermittent-feed CHS machine.

[0006] With a "rotary" intermittent-feed CHS machine, as is disclosed in United States Patent No. 3,218,217, honeycomb core material is formed by feeding forward a single sheet of paper, longitudinally scoring the sheet, forming transverse lines of intermittent slits across the sheet, applying longitudinal strips of glue to the sheet,

and then folding and pleating the slitted sheet with a pair of meshing star wheels. The pleated sheet is then compressed between a pair of spaced guides to insure that the pleats are bonded to one another along the various glue lines to form a compressed honeycomb core. A disadvantage associated with the "rotary" CHS machine is that the slitting rolls, star wheels, and the drive ratio of the machine must be changed to produce honeycomb material of different thicknesses. The required change-over of parts reduces the efficiency and speed with which honeycomb core material may be produced. Yet another disadvantage is that the rotary CHS machine can only produce honeycomb core material of a limited width, i.e., 13-3/4" maximum. Yet a further disadvantage is that it uses only one roll of sheet material and is able to produce only a limited amount of core material.

[0007] With a "cutter stacker" intermittent-feed CHS machine, as is disclosed in United States Patent No. 4,113,712, a plurality of superimposed sheets of paper are glued together to form a composite web. Stripes of adhesive are then applied on an outside face of one of the sheets constituting one outside face of the composite web. A web feed is intermittently operable in cycles to feed forward horizontally an increment of the composite web and an intermittently operable drive drives the feed through a cycle with a dwell between successive cycles. A vertically disposed "guillotine" type knife is operable during each dwell for cutting the composite web into strips and for stacking the resulting strips in a vertical stack with the adhesive strips on the outside face of each strip adapted to engage the other outside face of an adjacent strip in the vertical stack. The stack is then compressed to bond the strips together so as to form the honeycomb material. A disadvantage of the "cutter-stacker" intermittent-feed CHS machine is the inefficient production speed, of approximately 400 cuts per minute, resulting from the use of a web feed which must start, accelerate, decelerate and stop during each cycle and the use of a "guillotine" knife which must come forward, cut, stop, come back and stop during each cutting cycle. The use of a "guillotine" knife also contributes to the production of honeycomb material of uneven thickness since the "guillotine" knife has a tendency to chop rather than cut the paper. Yet another disadvantage is that it can only produce honeycomb material of a limited width.

[0008] With a "horizontal blade" intermittent-feed CHS machine, as is disclosed in United States Patent No. 3,257,253, a plurality of superimposed sheets of paper are initially bonded together to form a composite web. Stripes of adhesive are then applied on an outside face of the web. The composite web is then fed vertically downwardly through an intermittently operable web take-up and then into a cutting station including a horizontally positioned knife which is operable intermittently in cycles to cut the web into strips. The strips are then stacked horizontally and compressed to form the web of honeycomb material. A disadvantage associated with

a "horizontal blade" intermittent-feed CHS machine is the extremely inefficient production speed resulting from the use of an intermittently operable web take-up and a horizontal knife which has a straight back and forth motion. The horizontal knife is also disadvantageous because it has a tendency to chop rather than cut the web, thus leading to the production of honeycomb material of uneven thickness. Yet another disadvantage is that it can only produce honeycomb material of a limited width.

[0009] Thus, there remains a need for a continuous, rather than intermittent, feed CHS machine which allows for the production of honeycomb material at efficient production speeds in excess of 700 cuts per minute. There also remains a need for a continuous-feed CHS machine which produces honeycomb material of substantially uniform thickness. Further, there remains a need for a continuous-feed CHS machine wherein the width of the honeycomb material is unlimited. There also remains a need for a continuous-feed CHS machine that is capable of switching from the production of honeycomb material of one thickness or cell size to the production of honeycomb material of another thickness or cell size quickly and efficiently.

Summary of the Invention

[0010] The present invention is a machine for the production of a continuous honeycomb web which includes a cutting assembly for successively and continuously cutting a sheet of material, to which adhesive has been applied, into a plurality of strips, the adhesive causing the plurality of strips to adhere to each other to form the continuous honeycomb web. The sheet of material continuously passes and intermittently bubbles over a curved support.

[0011] A springing assembly urges the sheet of material back against the curved support in response to bubbling of the sheet of material away from the curved support.

[0012] The springing assembly includes a plurality of line assemblies positioned adjacent the curved support, the sheet of material contacting and exerting an outward force to the line assemblies during bubbling of the sheet of material causing the line assemblies to move outwardly, the line assemblies then contracting and exerting an inward force to the sheet of material to urge the sheet of material back against the curved support.

[0013] The cutting assembly includes a knife assembly disposed transversely to the sheet of material for cutting the sheet of material horizontally along its width into a plurality of strips, the knife assembly including a reciprocating knife and a stationary knife, a frame for mounting the reciprocating knife, and a camshaft assembly operatively associated with the knife assembly for providing a horizontal reciprocating scissors action to the reciprocating knife.

[0014] The machine further includes a packing table for packing the strips of material and a packing bar for

pushing the strips of material on the packing table away from the cutting assembly into abutting relation with previously cut strips on the table, the adhesive previously applied to sheet of material causing the strips to adhere to each other thereby forming a continuous honeycomb web.

Brief Description of the Drawings

[0015] In the accompanying drawings which form a portion of this disclosure:

FIGURES 1A and 1B are side views, with some parts simplified, of a continuous-feed CHS machine constructed in accordance with the present invention;

FIGURE 2 is an enlarged broken perspective view of the first station of the continuous-feed CHS machine depicted in FIGURE 1B and, more particularly, the manifold assemblies thereof;

FIGURE 3 is an enlarged broken perspective view of the third station of the continuous-feed CHS machine depicted in FIGURE 1B and, more particularly, the pull roll assembly, the curved support, the cutting assembly, the packing assembly and the run-off table thereof;

FIGURE 4A is a broken vertical cross-section of the third station of the continuous-feed CHS machine, taken along the line 4A-4A of FIGURE 3, depicting the web positioned against the surface of the curved support at the beginning of a cutting cycle;

FIGURE 4B is a broken vertical cross-section of the third station of the continuous-feed CHS machine, similar to FIGURE 4A, depicting the web bubbled away from the surface of the curved support during the cutting cycle;

FIGURE 5 is a broken perspective view of the cutting assembly of the continuous-feed CHS machine; and

FIGURES 6A-6D are simplified plan views depicting the reciprocating double scissors action of the cutting assembly depicted in FIGURE 5.

Description of the Preferred Embodiment

[0016] Referring to the drawings and, more particularly, FIGURES 1A and 1B, there is depicted therein a continuous-feed machine 20 for the production of a continuous honeycomb web.

[0017] Referring to FIGURE 1A, machine 20 includes a roll stand 22 including a frame 24 defined by horizontal tube members 25 and upstanding supports 26. A plurality of rolls of sheet material 27 such as paper or the like which are mounted on a plurality of shafts 28, are mounted and spaced along the length of the frame 24.

[0018] The sheet material is unwound from each of the rolls 27 to form a plurality of continuous sheets of material 30-35 having a first face 42 and a second face

44.

[0019] Each of the roll shafts 28 has a pneumatic brake 46 operatively connected thereto which allows for the variance and control of the speed, and thus the tension, at which the sheets of material unwind from rolls 27.

[0020] According to the invention, the tube members 25 are hollow to allow the flow of pressurized air from an air source (not shown) through the tube members 25 and into the brakes 46 by means of air lines 50 between members 25 and brakes 46. The pressurization of the tube members 25 eliminates the need to run lengthy external air lines from an air source to each of the brakes 46 and thus eliminates the inherent risks associated therewith such as puncture of the air lines with tools, etc.

[0021] Referring to FIGURE 1B, the machine 20 further includes a first station 52 into which the sheets of material 30-35 are fed. The first station 52 includes a frame 54 with a base 56 and an upper frame member 58. The base 56 includes an elevated deck 60 with a plurality of panels 62. Each of the panels 62 are spaced from each other to define slits 63 therebetween which extend substantially the width of panel 62.

[0022] A plurality of brake roller assemblies 64-68 are disposed beneath the deck 60. The brake roller assemblies 64-68 are spaced in parallel relation along the length of base 56. Each of the brake roller assemblies 64-68 is comprised of three elongate and rotatable shafts 69, 70 and 72. The shafts 69, 70 and 72 are parallel to each other and extend the width of the base 56. The shafts 69 and 70 are geared and coupled to each other at one end for rotation. The shaft 72 is also rotatable but independently of shafts 69 and 70. Each of the brake roller assemblies 64-68 further comprises a brake assembly 71 including a brake caliper 71a operatively associated with a brake rotor 71b mounted to the shaft 70 (FIGURE 2). According to the invention, the panels 62 are hingedly connected to the deck 60 so that panels 62 may be opened to allow access to and maintenance of the brake roller assemblies 64-68 therein.

[0023] Referring to FIGURES 1B and 2, the first station 52 further includes a plurality of adhesive manifold assemblies 73-77 which are positioned and spaced along the length of the upper frame member 58. Referring to FIGURE 2, each of the adhesive manifold assemblies 73-77 is positioned transversely to the upper frame member 58 and extends the width thereof. Further, each of the adhesive manifold assemblies 73-77 is aligned approximately co-planarly with each of the brake roller assemblies 64-68, respectively.

[0024] Each of the adhesive manifold assemblies 73-77 includes a pair of parallel and co-planar bars 78 and 79, which extend the width of, and are bracketed to, the upper frame member 58. Each of the adhesive manifold assemblies 73-77 further includes an elongate adhesive manifold 82 which, similarly to bars 78 and 79, also extends the width of the upper frame member 58. The manifold 82 is positioned between and spaced from

bars 78 and 79. Manifold 82 is secured to bar 78 by clamps 84. Manifold 82, preferably made of copper, is hollow and includes a plurality of holes (not shown) which, preferably, are drilled therethrough and spaced along the length thereof. Adhesive is fed from an adhesive source (not shown) through a plurality of adhesive filter assemblies 88, then through adhesive supply lines 90, into respective hollow manifolds 82 and finally through the holes therein onto the sheets of material 30-34. According to the invention, the holes in manifold 82 of manifold assemblies 73, 75 and 77 are aligned and co-planar to each other while the holes in manifold 82 of manifold assemblies 74 and 76 are aligned and co-planar to each other but offset from the holes in manifold 82 of manifold assemblies 73, 75 and 77.

[0025] As shown in FIGURE 1B, the first station 52 further includes a brake roller assembly 92 secured to the top of upper frame member 58. The brake roller assembly 92 is comprised of rotatable, elongate and parallel shafts 94 and 96 which extend the width of the upper frame member 58.

[0026] Still referring to FIGURE 1B, the machine 20 further includes a second station 98 comprising a plurality of rollers 100-104 which are secured to the top of the upper frame member 58. The rollers 100-104 are positioned transversely along the length of the upper frame member 58 and are spaced from each other in parallel relation. Each of the rollers 100-104 extends the width of the upper frame member 58. The rollers 100-104 are aligned generally co-planarly with the manifold assemblies 73-77, respectively.

[0027] As shown in FIGURES 1B and 4A, the machine 20 further includes a compression roller assembly 105 comprised of roller 100 and an elongate and rotatable roller 106 disposed adjacent to and directly above roller 100. The roller 106, like the roller 100, extends the width of machine 20. The roller 106 is mounted on a roller support 106a which biases the roller 106 against the roller 100. Although not shown, the rollers 100 and 106 are geared and coupled to each other for rotation. Preferably, each of the rollers 100 and 106 is made of rubber or other suitable material.

[0028] As shown in FIGURES 1B and 4A, the machine 20 includes a slitter assembly 107, located in front of the compression roller assembly 105, which comprises a pair of spaced, elongate and parallel shafts 108a and 108b which extend the width of and are secured to the machine 20 by brackets 109. A circular slitter blade 110 is secured to and surrounds the shaft 108a. A circular roll guide 111 is secured to and surrounds the shaft 108b. The slitter blade 110 and the roll guide 111 may be moved to any desired position along the length of the shafts 108a and 108b, respectively. A chain 112 connects the shafts 108a and 108b for coupled and simultaneous rotation. A motor 112a, via chain 112b connected to the shaft 108b, supplies the rotary slitter motion to the shafts 108a and 108b and thus to the slitter blade 110 and roll guide 111, respectively.

[0029] Referring to FIGURES 1B and 4A, the machine 20 further includes a hollow web adhesive manifold 112 which is located on top of the machine 20 in front of the compression roller assembly 106 and is similar in structure to adhesive manifolds 82. The web manifold 112 extends the width of the machine 20.

[0030] As shown in FIGURES 1B, 3 and 4A, the machine 20 further includes a third station 114. The third station 114 is comprised initially of a pull roll assembly 116 which is located near the top of third station 114 and adjacent web adhesive manifold 112. The pull roll assembly 116 includes a pair of elongate, parallel and adjacent rotatable rollers 118 and 120 which extend the width of third station 114. Each of the rollers 118 and 120 includes a plurality of ribs 122 (not shown for roller 120) positioned and spaced along the length thereof. The ribs 122 extend around the circumference of each of the rollers 118 and 120. Although not shown, the rollers 118 and 120 are geared and coupled to each other for rotation. The roller 118 is mounted on a roller support 121 which biases the roller 118 against the roller 120. A pull roll assembly gear motor (not shown), operatively associated and connected to a machine drive motor (not shown), provides the power to rotate rolls 118 and 120. Referring to FIGURE 4A, a chain 123 connects the roller 120 of pull roll assembly 116 to the roller 100 of compression roller assembly 105 thereby connecting the pull roll assembly 116 and the compression roller assembly 105 for coupled rotation.

[0031] Referring to FIGURES 3, 4A and 4B, the third station 114 also includes a curved support or accumulator bed 124 which extends generally downwardly from the pull roll assembly 116 to the edge of a blade header 163. According to the invention, the support 124 is composed of expanded metal. Alternatively, the support 124 may be composed of a solid sheet of metal with a plurality of holes punched therein. Although a metal sheet is preferred, the curved support 124 may be composed of any other suitable material.

[0032] Associated with the curved support 124 is a springing assembly 125 (FIGURE 4A). The springing assembly 125 includes an upper or first line bar 126, positioned in front of the adhesive manifold 112 and behind pull roll assembly 116 which extends the width of the machine 20 and is secured to and positioned away from the surface of curved support 124 by brackets 127. The springing assembly 125 additionally includes a second line bar 128, positioned below the pull roll assembly 116 and generally adjacent to an intermediate portion of curved support 124, which extends the width of sheet 124 and is secured to and positioned away from the surface of support 124 by brackets 129.

[0033] The springing assembly 125 also includes a spring bar 130, positioned below the line bar 128, which extends the width of the support 124 and is secured to and positioned away from the surface of curved support 124 by upstanding brackets 131 which are secured to the top of the blade header 163 and extend transversely

to the spring bar 130. Each of the brackets 131 includes a fixed outer member 131a and an inner member 131b which is hingedly connected to the outer member 131a. The ends of the spring bar 130 are connected to the upper end portion of the inner members 131b, respectively.

[0034] The springing assembly 125 further includes a line guide bar 132, positioned generally adjacent to the lower end of the curved support 124, which extends the width of curved support 124 and is secured to and positioned a distance away from the surface of support 124 by the upstanding brackets 131 which are secured to the top of blade header 163. The brackets 131 extend transversely to the line guide bar 132. The ends of the line bar 132 are secured to the lower end portion of the inner members 131b, respectively of brackets 131. The line guide bar 132 has a plurality of rotatable line guides 134 positioned and spaced along the length thereof. Each of the line guides 134 has a peripheral groove 136.

[0035] The springing assembly 125 further comprises a plurality of spring line assemblies 138 which are positioned above and adjacent support 124 in spaced and parallel relation along the width thereof. Each of the spring line assemblies 138 includes a spring 140 which has one end connected to the spring bar 130 and a line 142 which is connected to the other end of spring 140. The line 142 extends from the spring 140 around a respective line guide 134 on lower line bar 132, then upwardly over the surface of support 124, then under line bar 128 and roll 118 of pull roll assembly 116. The line 142 is then secured to the upper line bar 126. Alternatively, and although not shown, each of the spring line assemblies 138 may start from the line bar 128 instead of the line bar 130.

[0036] The springing assembly 125 further comprises a plurality of line assemblies 143 which are positioned above and adjacent the upper end portion of support 124 in spaced and parallel relation along the width thereof. Each of the line assemblies 143 includes a line 143a having one end connected to the line bar 123. The line 143a then extends upwardly over the surface of the upper end portion of support 124, then between rolls 118 and 120 of pull roll assembly 116. The line 143a is then secured to the upper bar 126 between two corresponding lines 142 of spring line assemblies 138. The lines 143a and the lines 142 are positioned so as to be alternately disposed with respect to each other in the area defining the upper end portion of support 124.

[0037] The third station 114 further includes a pair of knobs 146 which are secured, adjacent the line guide bar 132, to opposite ends of the blade header 163. Each of the knobs 146 is mounted on a bracket 150 and includes a distal end 149 which abuts the line guide bar 132. Each of the knobs 146 may be loosened to allow the movement of the line guide bar 132 and the spring line assemblies 138 away from the support 124 in the direction of arrow A thereby simplifying the adjustment or repair of structures associated with the third station 114 without interference by the spring line assemblies

138.

[0038] Referring to FIGURES 3, 4A and 4B, the third station 114 further includes a cutting assembly 154 below and downstream of the curved support 124. The cutting assembly 154 includes a knife assembly 156, disposed transversely to support 124, which includes a reciprocating knife 158 and a stationary knife 160. The stationary knife 160 is mounted to the bottom of the blade header 163. The reciprocating knife 158 has an elongate blade 161 mounted on an elongate blade holder 162 (FIGURE 6D). A wear plate 165 is mounted to the top surface of the blade holder 162 and is positioned behind the blade 161. According to the invention, the blade holder 162 is made of aluminum and the blade 161 extends approximately 0.75 inches (1.90 centimeters) over the outer edge of blade holder 162. The blade 161 is preferably approximately 0.50 inches (1.27 centimeters) thick. A pair of spaced connecting rods 164 are secured to the rear of blade holder 162 and extend rearwardly therefrom. The blade holder 162 also includes a guide arm 166 (FIGURES 6A-6D) secured to one end thereof.

[0039] Referring to FIGURE 5, the reciprocating knife 158 is mounted on a frame 163 including a horizontal base plate 170 and vertical side plates 172 which are secured to the ends of base plate 170. The base plate 170 has a pair of spaced guide rollers 174 (FIGURES 6A-6D) secured to the surface thereof. The guide arm 166 on blade holder 162 is positioned between guide rollers 174 for guiding the movement of the reciprocating knife 158. Also associated with the knife assembly 156 is a blade hold-down plate 167 (FIGURES 4A and 4B) which is mounted to the bottom surface of the rear portion of the blade header 163. The plate 167 contacts the wear plate 165 and holds the knife 158 down against the frame 168. A packing bar 171 (FIGURES 4A and 4B) is secured to the front of the blade holder 162 and extends the length thereof. Preferably, the packing bar 171 is the same thickness as the distance which the blade 161 extends over the edge of the blade holder 162, i.e., approximately 0.75 inches. The width of the packing bar 171 is dependent upon the thickness of the core material which is being produced. For example, if core having a thickness of approximately 2 inches (5 centimeters) is to be produced, the packing bar 171 would have a width of approximately 1.50 inches (3.81 centimeters) since the thickness of the blade 161 is approximately 0.50 inches.

[0040] Referring to FIGURES 5 and 6D, the cutting assembly 154 further includes a camshaft assembly 176 operatively associated with the knife assembly 156 for providing a horizontal reciprocating double scissors action to the reciprocating knife 158. The camshaft assembly 176 is mounted behind the knife assembly 156 and is seated on a table 178 in an interior chamber 180 of third station 114.

[0041] The camshaft assembly 176 includes a rotatable camshaft 182 having a pair of cams 183 and 184,

a pair of fly wheels 186, and a pair of connecting rods 187 and 188. Each of the rods 187 and 188 has an end which surrounds cam 183 and 184 respectively. The other ends of connecting rods 187 and 188 are coupled to the ends of connecting rods 164 of the blade holder 162. According to the invention, the cams 183 and 184 are offset from each other in a range between approximately 15 to 20 degrees. The power to rotate the camshaft 182 is supplied by the same machine drive motor (not shown) identified earlier, which through the pull roll assembly gear motor, provides the power to pull roll assembly 116. Such power is supplied to the camshaft 182 via belt 192 which is mounted on a pulley 194 secured to the end of camshaft 182. The rotation of the camshaft 182 causes the rotation of cams 183 and 184 which causes the longitudinal movement of rods 187 and 188 as depicted in FIGURES 6A-6D, which in turn causes the reciprocating double scissors action of reciprocating knife 158 relative to stationary knife 160.

[0042] More particularly and, referring to FIGURE 6A, at the start of a cutting cycle, both rods 187 and 188 move forward in the direction of stationary knife 160, with the rod 187 moving forward an incrementally greater distance than the rod 188 such that the right half of reciprocating knife 158 is caused to swivel forwardly about center point 193 while the left half of reciprocating knife 158 is caused to swivel rearwardly about the center-point 193 approximately the same distance which the right half of knife 158 swivels forwardly.

[0043] At the half-cut or single scissors cut point of the cutting cycle (FIGURE 6B), rod 187 has completed its forward movement and is beginning its rearward movement away from the stationary knife 160 while rod 188 continues its forwardly movement such that the right half of reciprocating knife 158 has completed its cutting and is beginning to swivel rearwardly about center-point 193 away from stationary knife 160 and the left half of reciprocating knife 158 has swiveled forwardly about center point 193 in the direction of stationary knife 160 to begin its cutting.

[0044] At the full-cut or double scissors cut point of the cutting cycle (FIGURE 6C), the rod 188 has moved yet further forwardly and the rod 187 has continued to move rearwardly such that the right half of reciprocating knife 158 has continued its rearward movement from stationary knife 160 and the left half of reciprocating knife 158 has moved forwardly into its cutting position over the stationary knife 160. In the full-open point of the cutting cycle (FIGURE 6D), the reciprocating knife 158 has completed its full cut and the rod 188 has moved back rearwardly away from stationary knife 160 while rod 187 has ended its rearward movement and is beginning once again to move forwardly towards the stationary knife 160 to start the next cutting cycle (FIGURE 6A).

[0045] According to the invention, the cutting assembly 154 is capable of performing in excess of 700 such cutting cycles per minute, which is an improvement over currently accurate cutting assemblies of more than 300

cycles per minute. Further, and unlike current knife assemblies, the knife assembly 156 cuts the paper rather than chops it.

[0046] The third station 114 also includes a packing assembly 196 comprised of a packing table 198 and the packing bar 171 which is mounted to the front of the reciprocating knife 158 (FIGURES 3 and 4A-4B). Pneumatic jacks 208 (FIGURES 4A and 4B), operable to adjust the height of table 198, are positioned beneath the table 198.

[0047] The machine 20 further includes a moveable run-off table 226, with an inclined top 228, which is positioned adjacent to and abuts the end of packing table 198 (FIGURES 1B and 4B).

[0048] According to the invention, the machine 20 produces a continuous web of honeycomb material as described below.

[0049] Initially, and referring to FIGURE 1A, the sheets of material 30-35 are unwound from rolls 27 and the brakes 46 on shafts 28 are operable to control the speed and tension at which the sheets of material unwind from the rolls 27. Then, as shown in FIGURE 1B, the sheets of material 30-34 are fed into the first station 52 through the deck 60 thereof and through brake roller assemblies 64-68, respectively. More particularly, and as the sheets 30-34 travel through the brake roller assemblies 64-68 respectively, each of the sheets 30-34 wraps around the shaft 69 of brake roller assemblies 64-68, respectively, then between shafts 69 and 70, around shafts 70 and 72, and then generally vertically upwardly towards sheet manifold assemblies 73-77, respectively.

[0050] Sheet 35, on the other hand, is fed upwardly through the brake roller assembly 92 which is secured to the top of the upper frame member 58. More particularly, sheet 35 is fed around shaft 94 of brake roller assembly 92, then between shafts 94 and 96 and then generally horizontally forwardly in the direction of arrow B and into the second station 98.

[0051] The brake roller assemblies 64-68 are advantageous since they assure that the sheets 30-34 remain taut, flat and unwrinkled as they travel vertically upwardly through the first station 52 towards the manifold assemblies 73-77. In a like manner, brake roller assembly 92 assures that the sheet 35 remains taut, flat and unwrinkled as the sheet 35 travels horizontally into and through the second station 98.

[0052] Still referring to FIGURE 1B, the sheets 30-34 then travel past sheet manifold assemblies 73-77, respectively. For example, and referring to FIGURE 2, sheet 32 is fed between bars 78 and 79 and manifold 82 of sheet manifold assembly 75. As the sheet 32 travels past the manifold 82, a plurality of spaced apart parallel lines of adhesive 230 are applied longitudinally to the face 42 of sheet 32. Lines of adhesive 230 are similarly applied to the face 42 of sheets 30, 31, 33 and 34. The lines of adhesive 230 on sheets 31 and 33 are offset from the lines of adhesive on sheets 30, 32 and 34 since

the holes in manifolds 82 of manifold assemblies 74 and 76 are offset from the holes in manifolds 82 of manifold assemblies 73, 75 and 77.

[0053] After adhesive has been applied to the sheets 30-34, and as shown in FIGURE 1B, they wrap around rollers 100-104, respectively of the second station 98 and then generally horizontally through second station 98 in the direction of compression roller assembly 105 and towards pull roll assembly 116. In the second station 98, the sheets 30-35 are superimposed and adhered to each other to form a six-ply composite web of material-232 having an inner face 234 and an outer face 236 (FIGURE 4A). The six-ply composite web 232 is formed by superimposing sheet 35 over sheet 34 with adhesive face 42 of sheet 34 contacting and adhering to face 44 of sheet 35. Then, sheet 34 is superimposed over sheet 33 with adhesive face 42 of sheet 33 contacting and adhering to face 44 of sheet 34. Further, sheet 33 is superimposed over sheet 32 with adhesive face 42 of sheet 32 contacting and adhering to face 44 of sheet 33. Then, sheet 32 is superimposed over sheet 31 with adhesive face 42 of sheet 31 contacting and adhering to face 44 of sheet 32. Finally, sheet 31 is superimposed over sheet 30 with adhesive face 42 of sheet 30 contacting and adhering to face 44 of sheet 31 to complete the six-ply composite web 232.

[0054] Referring to FIGURE 4A, the web 232, traveling in the direction of arrow B, then passes between the rollers 100 and 106 of compression roller assembly 105 where the sheets 30-35 comprising the web 232 are compressed to improve the bond between the sheets and thus the integrity of web 232. The compressive force applied to the web 232 may be varied by adjusting the position of the roller 106 on roller support 106a.

[0055] After passing through the compression roller assembly 105, the web 232 passes through the slitter assembly 107 and, more particularly, between shafts 108a and 108b of slitter assembly 107. There, the web 232 may be cut vertically along its edges by the slitter blade 110. According to the invention, the slitter blade 110 and the roll guide 111 may be slid to any position along the length of the shafts 108a and 108b, respectively to allow the slitting of the web 232 into two sections. For example, if it is desired to slit the web 232 into two sections of equal width, the blade 110 and roll guide 111 would be moved to the center of shafts 108a and 108b, respectively.

[0056] Thereafter, and as shown in FIGURES 1B and 4A, the web 232 travels past web manifold 112 where a plurality of spaced apart parallel lines of adhesive 237 (FIGURE 3), similar to lines of adhesive 230, are applied longitudinally to the face 236 of web 232 and, more particularly, face 42 of sheet 35.

[0057] Referring to FIGURES 1B, 3, 4A and 4B, the web 232 is then pulled through and between rotating rollers 118 and 120 of pull roll assembly 116 by the ribs 122 thereon which contact web 232. The lines of adhe-

sive 237 on face 236 of web 232 remain undisturbed as the web 232 is pulled therebetween since they pass between ribs 122. The pressure or bias of ribs 122 on the web 232 may be varied by adjusting the position of the roller 120 on roller support 121.

[0058] According to the invention, the speed of the pull rollers 118 and 120 may be varied to vary the speed at which the web 232 is pulled through the pull roll assembly 116. The speed of the pull rollers 118 and 120 thus not only controls the speed of the web 232 but also the speed at which the sheets of material 30-35 unwind from the rolls 27 and travel through the first and second stations 52 and 98, respectively.

[0059] Referring to FIGURES 3 and 4A-4B, the web 232 then travels downwardly over the surface of the curved support 124 past the cutting assembly 154 into abutting relation with the surface of the packing table 198 of packing assembly 196. At this point, the web 232 is cut into a plurality of successive web strips 238 by the reciprocating knife 158. To cut a single strip 238, the reciprocating knife 158 must complete one full double scissors cutting cycle as described earlier and as shown in FIGURES 6A-6D. More particularly, the motion of the reciprocating knife 158 as shown in FIGURES 6A and 6B scissor cuts the left half of the web 232 horizontally along the width thereof (as viewed from FIGURE 3) while the motion of the reciprocating knife 158 as shown in FIGURE 6C scissor cuts the right half of web 232 (as viewed from FIGURE 3) horizontally along the width thereof. After one cutting cycle has been completed and a strip 238 has been cut, the web 232 is advanced once again into abutting relation with the surface of the packing table 198 just prior to the start of the next cutting cycle so that the next strip 238 can be cut. Each of the strips 238 has a width determined by the height of the packing table 198 and a length equal to the width of the web 232. The inner and outer faces 234 and 236 respectively of web 232 now become the faces of the strips 238.

[0060] According to the invention, the curved support 124, in combination with the spring line assemblies 138 and line assemblies 143, allow the web 232 to be continuously fed and advanced towards the cutting assembly 154 into abutting relation with the surface of the packing table 198 during each successive cutting cycle without any buckling or wrinkling of the web 232.

[0061] To assure the production of a honeycomb web of even thickness, it is imperative that the web 232 be cut into a plurality of web strips 238 of even width. In order to produce web strips 238 of even thickness, the web 232 which is advanced toward the cutting assembly 154 must be free of wrinkles or buckles. This is accomplished by assuring that, immediately prior to the start of a cutting cycle, the web 232 is positioned flat against the surface of the curved support 124 and the packing table 198 as shown in FIGURES 3 and 4A. When so positioned, the web 232 is free of wrinkles and strips 238 of even width may be cut.

[0062] However, at the end of a cutting cycle, and as a result of the movement of reciprocating knife 158 coupled with the continuous downward movement of the web 232 towards the packing table 198, the web 232 is caused to bubble or wave away from the surface of the curved support 124 and thus wrinkles or buckles are formed (FIGURE 4B).

[0063] In order to remove such wrinkles from the web 232, the web 232 must be returned to the surface of the curved support 124 prior to the start of the next cutting cycle. This is accomplished by the spring line assemblies 138 and line assemblies 143 (FIGURES 3, 4A and 4B). As a result of its bubbling away from the surface of the curved support 124, the web 232 comes into contact with and exerts an outward force to lines 142 which causes the springs 140 attached to spring bar 130 to expand. Once the web 232 has completed its outward bubble movement, the springs 140 then contract and the lines 142 exert an inward force to the web 232 which causes the web 232 to return to the surface of the curved support 124 prior to the start of the next cutting cycle. The curved support 124 is preferably constructed of expanded material such as metal to allow the removal of the air disposed between the web 232 and sheet 124. It is understood that the frequency of the bubbling may be as great as 700 times per minute when the cutting assembly 154 is set to perform 700 cuts per minute.

[0064] The line assemblies 143 extending between the line bars 126 and 128 are particularly advantageous when the web 232 is cut into wide strips 238. More particularly, when the web 232 is cut into wide strips 238, there is a tendency for the bubble in the web 232 to start closer to the top of support 124 and a tendency for the bubble to bubble a greater distance away from the surface of support 124 in the region between the line bar 128 and the pull roll assembly 116. The line assemblies 143 assure that the web 232 is returned to the surface of the curved support 124 prior to the start of each shortened cutting cycle.

[0065] The plurality of cut web strips 238 (FIGURES 4A and 4B), positioned vertically on top of the packing table 198, are then packed and adhered to each other on the packing table 198 to form a continuous honeycomb web 240 having a thickness equal to the width of the strips 238 and a length equal to the length of the strips 238. More particularly, and referring to FIGURES 4A and 4B, the packing bar 171 secured below the reciprocating knife 158 pushes a web strip 238 which has just been cut away from the cutting assembly 154 into abutting relation with a previously cut strip 238. The adhesive face 236 of the strip 238 which has just been cut is abutted against and adhered to the face 234 of the previously cut web strip 238 which is already part of the continuous honeycomb web 240. As strips 238 are continually cut, advanced, and then packed, the honeycomb web 240 is caused to advance onto the inclined run-off table 226 where the web 240 is further compressed and the adhesive is allowed to completely dry.

[0066] According to the invention, the number of pounds of web 240 which can be produced is dependent upon the speed of the web 232, the number of cuts which machine 20 has been set up to perform and the width of the strips 238 which are cut. That is, as the speed of web 232 and the number of cuts per minute are increased, more strips 238 are cut and thus more honeycomb web 240 is produced. Similarly, the number of pounds of honeycomb web 240 produced will increase as the width of the strips 238 is increased.

[0067] With machine 20 according to the present invention, the speed of the web 232 and the length of the cutting cycle of cutting assembly 154 may be simply and efficiently adjusted while the machine 20 is in operation since both the speed of the pull rollers 118 and 120 and the cutting cycle length are simultaneously controlled through the machine drive motor (not shown) which drives both the pull roll assembly 116 and the cutting assembly 154.

[0068] According to the invention, the adjustment of a drive motor control dial (not shown) on the drive motor, while machine 20 is operating, automatically and simultaneously adjusts both the speed of pull rolls 118 and 120 and the cutting cycle length of cutting assembly 154. Thus, and unlike currently available machines, there is no need to stop the machine and change gears or other parts to vary the speed of the web 232 and the cutting assembly 154.

[0069] Additionally, with the machine 20 according to the present invention, and unlike other machines, the width of strips 238 and thus the thickness of the honeycomb web 240 may be simply varied by adjusting the height of the packing table 198 and the speed of the machine drive motor. For example, to produce honeycomb web 240 of greater thickness, the table 198 would be lowered to increase the width of the web strips 238 which are cut and the speed of the machine drive motor would be increased to increase the speed of the cutting assembly 154. To produce honeycomb web 240 of lesser thickness, the table 198 would be appropriately elevated so that web strips 238 of lesser width are produced and the speed of the machine drive motor would be decreased.

[0070] Still further, with machine 20 according to the present invention, the size of the cells which comprise the honeycomb web 240 may be quickly and efficiently varied. The cell size of web 240 is determined by the distance between holes (not shown) in adhesive manifolds 82 and 112. For example, to produce a web 240 having a cell size of approximately 0.50 inches (1.27 centimeters), manifolds 82 and 112 having holes therein spaced apart a distance of approximately 1.0 inches (2.54 centimeters) are used. To produce a web 240 having a cell size of approximately 0.25 inches (0.63 centimeters) requires the use of manifolds 82 and 112 having holes therein spaced a distance of 0.50 inches. Thus, according to the invention, the switch from production of 0.50 inches cell size web to 0.25 inch cell size

web simply requires the change of manifolds 82 and 112. With machine 20, the changeover is a procedure requiring approximately 15-30 minutes. With prior machines, the cell size changeover might take well over one hour.

[0071] The foregoing is illustrative of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described. Accordingly, all suitable modifications and equivalents may be resorted to while still falling within the scope of the invention.

Claims

1. A machine for the production of a continuous honeycomb web comprising:

a roll stand (22) for supporting a plurality of rolls of sheet material (27), the sheet material being unwound from each of the rolls to form a plurality of continuous sheets of material (30-35), each of the sheets having a first (42) and second (44) face;

a first station (52) including a plurality of adhesive manifold assemblies (73-77) for applying spaced apart lines of adhesive longitudinally on the first face of selected sheets of material;

a second station (98) including a plurality of spaced and parallel rollers (100-104) for superimposing and adhering the sheets of material together to form a composite web (232), the composite web having an inner face (234) and an outer face (236);

a web manifold assembly (112) for applying lines of adhesive to the outer face of the composite web; and

a third station (114) including:

a pull roll assembly (116) for pulling the web;

a cutting assembly (154) for successively cutting the web into a plurality of web strips;

a packing assembly (196) for packing cut web strips into abutting relation with previously cut web strips, the lines of adhesive previously applied to the outer face of the web causing the plurality of cut web strips to adhere to each other thereby forming a continuous honeycomb web; **characterized in that** the pull roll assembly (116) is for continuously pulling the web and the cutting assembly (154) is for successively and continuously cutting the web and a curved support (124) between the pull roll assembly and the cutting assembly is pro-

- vided, the web continuously passing downwardly from the pull roll assembly into the cutting assembly and intermittently bubbling over the curved support to spring the web into the cutting assembly. 5
2. The machine of claim 1, wherein the roll stand (22) includes a frame (24) having a plurality of spaced and parallel shafts (28) mounted thereon for rotation, the rolls being mounted on the roll shafts (28) respectively, each of the roll shafts including a pneumatic brake (46) for varying the speed at which the sheet material unwinds from the rolls, the frame including hollow tube members (25) through which pressurized air flows, the brakes being operatively connected to the tube members for the transfer of pressurized air from the tube members to the brakes (46). 10 15
 3. The machine of claim 2, further comprising a plurality of air lines (50) for transferring the air from the tube members to each of the brakes, one end of each of the air lines being connected to the tube members and the other end of each of the air lines being connected to each of the brakes respectively. 20 25
 4. The machine of claim 1, wherein the first station includes:
 - a) a frame having a deck (60) and an upper frame member (58), the plurality of adhesive manifold assemblies (73-77) being positioned along the length of the frame and being secured to the upper frame member in spaced and parallel relation transverse thereto; and 30 35
 - b) a plurality of first brake roller assemblies (64-68) along the deck of the frame, the brake roller assemblies being spaced in parallel relation along the length of the deck (60), each of the brake roller assemblies being aligned approximately co-planarly with each of the sheet manifold assemblies on the upper frame member, the selected sheets of material being fed through the first brake roller assemblies respectively and thereafter generally vertically upwardly past a respective sheet manifold assembly wherein the lines of adhesive are applied to the first face of each of the selected sheets of material. 40 45
 5. The machine of claim 4, wherein each of the brake roller assemblies has first, second and third elongate and parallel rotatable rollers, the selected sheets of material wrapping around the first, second and third shafts (69, 70, 72) of the brake roller assemblies, respectively. 50 55
 6. The machine of claim 4, wherein the deck comprises a floor including a plurality of removable panels (62) for allowing access to the brake roller assemblies.
 7. The machine of claim 4, wherein the deck comprises a floor including a plurality of slits, the plurality of sheets of material passing through the plurality of slits, respectively.
 8. The machine of claim 4, further comprising a second brake roller assembly (92) secured to the top of the upper frame member (58), one of the sheets of material being fed through the second brake roller assembly.
 9. The machine of claim 8, wherein the second brake roller assembly includes first and second elongate and parallel rotatable rollers, one of the sheets of material passing through the first and second rollers.
 10. The machine of claim 4, wherein each of the adhesive manifold assemblies comprises:
 - a) first and second parallel elongate bars (78,79) extending transversely to the upper frame member (58); and
 - b) an elongate adhesive manifold extending transversely to the upper frame member, the manifold being spaced from the first and second bars and secured to the first bar, the sheet of material being fed between the first and second bars and the manifold.
 11. The machine of claim 10, wherein each of the adhesive manifolds comprises a hollow tube (82) through which adhesive flows, the tube having a plurality of holes spaced along its length, the adhesive flowing through the holes onto the first face of the sheet of material passing in front of the respective manifold thereby forming parallel lines of adhesive thereon.
 12. The machine of claim 11, wherein the holes of selected manifolds are offset from the holes in other selected manifolds.
 13. The machine of claim 4, further comprising an adhesive filter assembly (88) operatively connected to each of the adhesive manifold assemblies for filtering the adhesive.
 14. The machine of claim 10, wherein each of the adhesive manifolds is made of copper.
 15. The machine of claim 1, wherein the first station in-

cludes a frame (24) having an upper frame member (58), the second station (98) including the plurality of rollers (100-104) secured to the top of the upper frame member (58), the rollers being positioned along the frame in spaced and parallel relation transverse to the upper frame member, the rollers being aligned generally co-planarly above the adhesive manifold assemblies respectively and the selected sheets of material passing around the rollers respectively, the sheets of material being disposed generally horizontally over said rollers and superimposed to each other, the first face of the sheets of material adhering to the second face of the sheets of material respectively to form the composite web.

16. The machine of claim 1, further comprising a compression roller assembly (105) between the first station and the pull roll assembly (116) for compressing the composite web.

17. The machine of claim 16, wherein the compression roller assembly (105) includes first and second elongate and adjacent rotatable rollers (100, 106), the web passing between the first and second rollers to compress the web.

18. The machine of claim 1, further comprising a springing assembly (125) for urging the web back against the surface of the curved support (124) in response to bubbling of the web away from the surface of the curved support, the springing assembly including a first line bar (126) positioned behind the pull roll assembly, a spring bar (130) positioned below the pull roll assembly, a line guide bar (132) positioned below the spring bar (130), and a plurality of first line assemblies (138), each of the first line assemblies including a spring (140) having one end connected to the spring bar and a line, the line of each of the first line assemblies having one end connected to other end of the spring and the other end connected to the first line bar, each of the lines extending downwardly from the spring bar around the guide bar then upwardly over the curved support then under the pull roll assembly towards the first line bar.

19. The machine of claim 18, wherein the springing assembly (125) further includes a second line bar (128, 132) positioned between the pull roll assembly and the spring bar and a plurality of second line assemblies (143) positioned adjacent the curved support, each of the second line assemblies including a line (143a) extending behind the pull roll assembly between the first and second line bars, the web contacting the lines during bubbling of the web and causing the lines to move outwardly, the lines then contracting and exerting an inward force to the web to urge the web back against the curved sup-

port.

20. The machine of claim 1, wherein the cutting assembly comprises:

a) a knife assembly (156) disposed transversely to the web for cutting the web horizontally along its width into a plurality of web strips, the knife assembly including a reciprocating knife (158) and a stationary knife (160);

b) a frame (168) including a horizontal base plate (170) for mounting the reciprocating knife, the reciprocating knife abutting and reciprocating along the surface of the base plate; and

c) a camshaft assembly (176) operatively associated with the knife assembly for providing a horizontal reciprocating scissors action to the reciprocating knife.

21. The machine of claim 20, wherein the reciprocating knife has a blade (161) mounted in a blade holder (162), the blade holder having a pair of spaced first connecting rods (164) at the rear, the camshaft assembly including a camshaft (182), having a pair of spaced second connecting rods (187, 188) coupled to the pair of first connecting rods respectively, the camshaft assembly further including first and second cams (183, 184) mounted on the camshaft for rotation therewith, the pair of second connecting rods each including an end which surrounds the first and second cams respectively for providing the reciprocating scissors action to the reciprocating knife.

22. The machine of claim 21, wherein the first cam (183) is offset from the second cam (184) in a range between approximately 15 to 20 degrees.

23. The machine of claim 20, wherein the frame includes the horizontal base plate (170) and first and second vertical side plates (172) secured to the ends of the base plate, the reciprocating knife abutting the base plate and reciprocating horizontally along the surface thereof.

24. The machine of claim 21, wherein the blade holder (162) is made of aluminum.

25. The machine of claim 20, wherein the frame includes a pair of spaced apart guide rollers (174) the reciprocating knife including a blade (161) mounted in a blade holder (162), the blade holder including a guide arm (166) at one end, the guide arm being positioned between the rollers for guiding the reciprocating knife.

26. The machine of claim 1, further comprising a slitter assembly, the slitter assembly (107) including a slitter blade (110) disposed parallel to the web for cutting the web vertically along its edges or into a plurality of webs.

27. The machine of claim 26, wherein the slitter assembly includes first and second rotatable shafts, the web passing between the first and second shafts, the slitter blade being mounted on the second shaft so as to be moveable along the length thereof.

28. A machine for the production of a continuous honeycomb web comprising:

a cutting assembly (154) for successively cutting a sheet of material to which adhesive has been applied into a plurality of strips, the adhesive causing the plurality of strips to adhere to each other to form the continuous honeycomb web;

a pull roll assembly (116) for pulling the sheet of material towards the cutting assembly; **characterised in that** the cutting assembly is for successively and continuously cutting the web, **in that** the pull roll assembly is for continuously pulling the web and **in that**

a curved support (124) between the pull roll assembly (146) and the cutting assembly (154) is provided, over which the sheet of material continuously passes directly into the cutting assembly and intermittently bubbles to spring the sheet of material into the cutting assembly.

29. The machine of claim 28, further comprising a springing assembly (125) for urging the sheet of material back against the curved support (124) in response to bubbling of the sheet of material away from the curved support.

30. The machine of claim 29, wherein the springing assembly (125) includes a plurality of line assemblies (143) positioned adjacent the curved support, the sheet of material contacting and exerting an outward force to the line assemblies during bubbling of the sheet of material causing the line assemblies to move outwardly, the line assemblies then contracting and exerting an inward force to the sheet of material to urge the web back against the curved support.

31. The machine of claim 28, wherein the springing assembly includes a first line bar (126) positioned behind the pull roll assembly, a spring bar (130) positioned below the pull roll assembly, a line guide bar (132) positioned below the spring bar, and a plurality of first line assemblies (137), each of the first line assemblies including a spring (146) having one end

connected to the spring bar and a line, the line of each of the first line assemblies having one end connected to the other end of the spring (140) and the other end connected to the first line bar, each of the lines extending downwardly from the spring bar around the line guide bar then upwardly over the curved support then under the pull roll assembly towards the first line bar (126).

32. The machine of claim 31, wherein the line guide bar includes a plurality of line guides (138) extending the length of the guide bar in spaced relation, the lines of the first line assemblies wrapping around the line guides, respectively.

33. The machine of claim 31, wherein the springing assembly further includes a second line bar (128) positioned between the pull roll assembly and the spring bar and a plurality of second line assemblies positioned adjacent the curved support, each of the second line assemblies including a line extending between the first and second line bars (126, 128), the sheet of material contacting the lines during bubbling of the sheet of material and causing the lines to move outwardly, the lines then contracting and exerting an inward force to the sheet of material to urge the web back against the curved support.

34. The machine of claim 28, wherein the cutting assembly comprises:

a) A knife assembly (156) disposed transversely to the sheet of material for cutting the sheet of material horizontally along its width into a plurality of strips, the knife assembly including a reciprocating knife (158) and a stationary knife (160).

b) a frame (168) for mounting the reciprocating knife; and

c) a camshaft assembly (170) operatively associated with the knife assembly for providing a horizontal reciprocating scissors action to the reciprocating knife.

35. The machine of claim 34, wherein the reciprocating knife has a blade (161) mounted in a blade holder (162), the blade holder having a pair of spaced first connecting rods (164) at the rear, the camshaft assembly including a camshaft having a pair of spaced second connecting rods (187, 188) coupled to the pair of first connecting rods respectively, the camshaft assembly further including first and second cams (183, 184) mounted on the camshaft for rotation therewith, the pair of second connecting rods being supported on first and second cams respectively for providing the reciprocating scissors

action to the reciprocating knife.

36. The machine of claim 35, wherein the first cam (173) is offset from the second cam (184) in a range between approximately 15 to 20 degrees. 5
37. The machine of claim 34, wherein the frame includes a horizontal base plate (178) and first and second vertical side plates (172) secured to the ends of the base plate, the reciprocating knife abutting the base plate and reciprocating horizontally along the surface thereof. 10
38. The machine of claim 35, wherein the blade holder (162) is made of aluminium. 15
39. The machine of claim 34, wherein the frame includes a pair of spaced apart guide rollers (174), the reciprocating knife including a blade mounted in a blade holder, the blade holder including a guide arm (166) at one end, the guide arm being positioned between the rollers for guiding the reciprocating knife. 20
40. The machine of claim 28, further comprising a packing table (178) for packing the strips of material and a packing bar (179) for pushing the strips of material on the packing table away from the cutting assembly into abutting relation with previously cut strips on the table, the adhesive previously applied to the sheet of material causing the strips to adhere to each other thereby forming a continuous honeycomb web. 25 30
41. The machine of claim 40, wherein the cutting assembly includes a reciprocating knife (158), the packing bar (171) being mounted below the reciprocating knife. 35
42. The machine of claim 40, further comprising means (208) for adjusting the height of the packing table to vary the width of the cut web strips. 40
43. The machine of claim 42, wherein the means for adjusting the height of the packing table comprises a pneumatic jack (208). 45

Patentansprüche

1. Maschine zum Herstellen einer fortlaufenden Wabenbahn, die aufweist:

ein Rollengerüst (22) zum Tragen einer Mehrzahl von Rollen aus dünnem Bahnenmaterial (27), wobei das Bahnenmaterial von jeder der Rollen abgewickelt wird, um eine Mehrzahl von fortlaufenden Materialbahnen (30-35) zu bil-

den, wobei jede der Bahnen eine erste (42) und eine zweite (44) Seite besitzt;
eine erste Station (52), die eine Mehrzahl von Klebemittel-Verteileranordnungen (73-77) zum Aufbringen von voneinander beabstandeten Linien aus Klebemittel längs auf die erste Seite der ausgewählten Materialbahnen umfasst;
eine zweite Station (98), die eine Mehrzahl von voneinander beabstandeten und parallelen Rollen (100-104) zum übereinanderliegenden Anordnen und Verkleben der Materialbahnen aneinander, um eine Komposit-Bahn (232) zu bilden, umfasst, wobei die Komposit-Bahn eine innere Seite (234) und eine äußere Seite (236) besitzt;
eine Bahn-Verteileranordnung (112) zum Aufbringen von Linien aus Klebemittel auf die äußere Seite der Komposit-Bahn; und
eine dritte Station (114), die umfasst:

eine Ziehrollenanordnung (116) zum Ziehen der Bahn;
eine Schneidanordnung (154) zum aufeinanderfolgenden Schneiden der Bahn in eine Mehrzahl von Streifenbahnen;
eine Packungsanordnung (196) zum Paketen der geschnittenen Streifenbahnen in einer aneinander anstoßenden Beziehung zu zuvor geschnittenen Streifenbahnen, wobei die Linien aus Klebemittel, zuvor auf die äußere Seite der Bahn aufgebracht, bewirken, dass die Mehrzahl der geschnittenen Streifenbahnen aneinander anhaften, um dadurch eine fortlaufende Wabenbahn zu bilden; **dadurch gekennzeichnet, dass** die Ziehrollenanordnung (160) zum kontinuierlichen Ziehen der Bahn dient und die Schneidanordnung (154) für ein aufeinanderfolgendes und kontinuierliches Schneiden der Bahn dient, und

wobei ein gekrümmter Träger (124) zwischen der Ziehrollenanordnung und der Schneidanordnung vorgesehen ist, wobei die Bahn kontinuierlich nach unten von der Ziehrollenanordnung in die Schneidanordnung führt und intermittierend über den gekrümmten Träger blasenartig läuft, damit die Bahn in die Schneidanordnung hinein federt.

- 50 2. Maschine nach Anspruch 1, wobei das Rollengerüst (22) ein Gestell (24) umfasst, das eine Mehrzahl von beabstandeten und parallelen Wellen (28) besitzt, die daran für eine Drehung befestigt sind, wobei die Rollen auf den Rollenwellen (28) jeweils befestigt sind, wobei jede der Rollenwellen eine pneumatische Bremse (46) zum Variieren der Geschwindigkeit umfasst, unter der sich das Bahnenmaterial von den Rollen abwickelt, wobei das Ge-

stell hohle Rohrelemente (25) umfasst, durch die Druckluft strömt, wobei die Bremsen betriebsmäßig mit den Rohrelementen für die Übertragung von Druckluft von den Rohrelementen zu den Bremsen (46) verbunden sind.

3. Maschine nach Anspruch 2, die weiterhin eine Mehrzahl von Luftleitungen (50) zum Überführen der Luft von den Rohrelementen zu jeder der Bremsen aufweist, wobei ein Ende jeder der Luftleitungen mit den Rohrelementen verbunden ist und wobei das andere Ende jeder der Luftleitungen mit jeder der Bremsen jeweils verbunden ist.

4. Maschine nach Anspruch 1, wobei die erste Station umfasst:

(a) ein Gestell, das eine Abdeckfläche (60) und ein oberes Gestellelement (58) besitzt, wobei die Mehrzahl der Klebmittel-Verteileranordnungen (73-77) entlang der Länge des Gestells positioniert ist und an dem oberen Gestellelement in einer beabstandeten und parallelen Beziehung quer dazu befestigt ist; und

(b) eine Mehrzahl von ersten Bremsrollenanordnungen (64-68) entlang der Abdeckfläche des Gestells, wobei die Bremsrollenanordnungen in einer parallelen Beziehung entlang der Länge der Abdeckfläche (60) beabstandet sind, wobei jede der Bremsrollenanordnungen ungefähr koplanar zu jeder der Bahnen-Verteileranordnungen auf dem oberen Gestellelement ausgerichtet ist, wobei die ausgewählten Materialbahnen über die ersten Bremsrollenanordnungen jeweils und danach im wesentlichen vertikal nach oben hinter eine jeweilige Bahn-Verteileranordnung zugeführt werden, wobei die Linien aus Klebmittel auf die erste Seite jeder der ausgewählten Materialbahnen aufgebracht werden.

5. Maschine nach Anspruch 4, wobei jede der Bremsrollenanordnungen eine erste, eine zweite und eine dritte langgestreckte und parallele, drehbare Rolle besitzt, wobei sich die ausgewählten Materialbahnen um die erste, die zweite und die dritte Welle (69, 70, 72) der Bremsrollenanordnungen jeweils herum wickeln.

6. Maschine nach Anspruch 4, wobei die Abdeckfläche einen Boden aufweist, der eine Mehrzahl von entfernbaren Platten (62) umfasst, um einen Zugang zu den Bremsrollenanordnungen zu ermöglichen.

7. Maschine nach Anspruch 4, wobei die Abdeckfläche einen Boden aufweist, der eine Mehrzahl von Schlitzten umfasst, wobei die Mehrzahl der Materi-

albahnen durch die Mehrzahl der Schlitzte jeweils hindurchführt.

8. Maschine nach Anspruch 4, die weiterhin eine zweite Bremsrollenanordnung (92) aufweist, befestigt an der Oberseite des oberen Rahmenelements (58), wobei eine der Materialbahnen durch die zweite Bremsrollenanordnung hindurch zugeführt wird.

9. Maschine nach Anspruch 8, wobei die zweite Bremsrollenanordnung eine erste und zweite, langgestreckte und parallele, drehbare Rolle umfasst, wobei eine der Materialbahnen durch die erste und die zweite Rolle hindurchführt.

10. Maschine nach Anspruch 4, wobei jeder der Klebmittel-Verteileranordnungen aufweist:

(a) einen ersten und einen zweiten, parallelen, langgestreckten Balken (78, 79), die sich quer zu dem oberen Gestellelement (58) erstrecken; und

(b) einen langgestreckten Klebmittelverteiler, der sich quer zu dem oberen Gestellelement erstreckt, wobei der Verteiler von dem ersten und dem zweiten Balken beabstandet und an dem ersten Balken befestigt ist, wobei die Materialbahn zwischen dem ersten und dem zweiten Balken und dem Verteiler zugeführt wird.

11. Maschine nach Anspruch 10, wobei jeder der Klebmittelverteiler ein hohles Rohr (82) aufweist, durch das Klebmittel fließt, wobei das Rohr eine Mehrzahl von Löchern besitzt, beabstandet entlang dessen Länge, wobei das Klebmittel durch die Löcher auf die erste Seite der Materialbahn fließt, die vor dem jeweiligen Verteiler hindurchführt, um dadurch parallele Linien aus Klebmittel darauf zu bilden.

12. Maschine nach Anspruch 11, wobei die Löcher von ausgewählten Verteilern zu den Löchern in den anderen, ausgewählten Verteilern versetzt sind.

13. Maschine nach Anspruch 4, die weiterhin eine Klebmittelfilteranordnung (88) aufweist, die betriebsmäßig mit jeder der Klebmittel-Verteileranordnungen zum Filtern des Klebmittels verbunden ist.

14. Maschine nach Anspruch 10, wobei jeder der Klebmittelverteiler aus Kupfer hergestellt ist.

15. Maschine nach Anspruch 1, wobei die erste Station ein Gestell (24) umfasst, das ein oberes Gestellelement (58) umfasst, wobei die zweite Station (98) die Mehrzahl der Rollen (100-104) umfasst, die an der Oberseite des oberen Gestellelements (58) befestigt sind, wobei die Rollen entlang des Gestells in

einer beabstandeten und parallelen Beziehung quer zu dem oberen Gestellelement positioniert sind, wobei die Rollen im wesentlichen koplanar oberhalb der Klebemittel-Verteileranordnungen jeweils ausgerichtet sind und die ausgewählten Materialbahnen um die Rollen herum jeweils hindurchführen, wobei die Materialbahnen im wesentlichen horizontal über den Rollen und übereinandergelegt zueinander angeordnet sind, wobei die erste Seite der Materialbahnen an der zweiten Seite der Materialbahnen ankleben, um die Komposit-Bahn zu bilden.

16. Maschine nach Anspruch 1, die weiterhin eine Kompressionsrollenanordnung (105) zwischen der ersten Station und der Ziehrollenanordnung (116) zum Komprimieren der Komposit-Bahn aufweist.
17. Maschine nach Anspruch 16, wobei die Kompressionsrollenanordnung (105) eine erste und eine zweite langgestreckte und angrenzende, drehbare Rolle (100, 106) umfasst, wobei die Bahn zwischen der ersten und der zweiten Rolle hindurchführt, um die Bahn zu komprimieren.
18. Maschine nach Anspruch 1, die weiterhin eine federnde Anordnung (125) zum Drücken der Bahn zurück gegen die Oberfläche des gekrümmten Trägers (124) auf das blasenartige Laufen der Bahn hin weg von der Oberfläche des gekrümmten Trägers ausweist, wobei die federnde Anordnung einen ersten linienförmigen Balken (126), positioniert hinter der Ziehrollenanordnung, einen Federbalken (130), positioniert unterhalb der Ziehrollenanordnung, einen linienförmigen Führungsbalken (132), positioniert unterhalb des Federbalkens (130), und eine Mehrzahl von ersten linienförmigen Anordnungen (138) umfasst, wobei jede der ersten linienförmigen Anordnungen eine Feder (140) umfasst, die ein Ende mit dem Federbalken und einem linienförmigen Teil verbunden besitzt, wobei das linienförmige Teil jeder der ersten linienförmigen Anordnungen ein Ende mit dem anderen Ende der Feder verbunden und das andere Ende mit dem ersten linienförmigen Balken verbunden besitzt, wobei sich jeder der linienförmigen Teile nach unten von dem Federbalken um den Führungsbalken herum, dann nach oben über den gekrümmten Träger, dann unter die Ziehrollenanordnung zu dem ersten linienförmigen Balken hin erstreckt.
19. Maschine nach Anspruch 18, wobei die federnde Anordnung (125) weiterhin einen zweiten linienförmigen Balken (128, 132), positioniert zwischen der Ziehrollenanordnung und dem Federbalken, und eine Mehrzahl von zweiten linienförmigen Anordnungen (143), positioniert angrenzend an den gekrümmten Träger, umfasst, wobei jede der zweiten

linienförmigen Anordnungen ein linienförmiges Teil (143a) umfasst, das sich hinter die Ziehrollenanordnung zwischen dem ersten und dem zweiten linienförmigen Balken erstreckt, wobei die Bahn die linienförmigen Teile während des blasenartigen Laufens der Bahn berührt und bewirkt, dass sich die linienförmigen Teile nach außen bewegen, wobei die linienförmigen Teile dann die Bahn zusammenziehen und eine nach innen gerichtete Kraft auf die Bahn aufbringen, um die Bahn zurück gegen den gekrümmten Träger zu drücken.

20. Maschine nach Anspruch 1, wobei die Schneidanordnung aufweist:

- (a) eine Messeranordnung (156), angeordnet quer zu der Bahn zum Schneiden der Bahn horizontal entlang deren Breite in eine Mehrzahl von Streifenbahnen, wobei die Messeranordnung ein sich hin- und herbewegendes Messer (158) und ein stationäres Messer (160) umfasst;
- (b) ein Gestell (168), das eine horizontale Basisplatte (170) zum Befestigen des sich hin- und herbewegenden Messers umfasst, wobei das sich hin- und herbewegende Messer an die Oberfläche der Basisplatte anstößt und sich entlang dieser hin- und herbewegt; und
- c) eine Nockenwellenanordnung (176), die betriebsmäßig der Messeranordnung zugeordnet ist, um eine horizontale sich hin- und herbewegende Scherenwirkung auf das sich hin- und herbewegende Messer auszuüben.

21. Maschine nach Anspruch 20, wobei das sich hin- und herbewegende Messer eine Schneide (161) besitzt, die in einem Schneidenhalter (162) befestigt ist, wobei der Schneidenhalter ein Paar von beabstandeten, ersten Verbindungsstäben (164) an der Rückseite besitzt, wobei die Nockenwellenanordnung eine Nockenwelle (182) umfasst, die ein Paar von beabstandeten, zweiten Verbindungsstäben (187, 188) besitzt, verbunden mit dem Paar der ersten Verbindungsstäbe jeweils, wobei die Nockenwellenanordnung weiterhin einen ersten und einen zweiten Nocken (183, 184) umfasst, befestigt an der Nockenwelle für eine Drehung zusammen damit, wobei das Paar der zweiten Verbindungsstäbe jeweils ein Ende umfasst, das den ersten und den zweiten Nocken jeweils umgibt, um die sich hin- und herbewegende Scherenwirkung auf das sich hin- und herbewegende Messer aufzubringen.
22. Maschine nach Anspruch 21, wobei der erste Nocken (183) zu dem zweiten Nocken (184) in einem Bereich zwischen ungefähr 15 bis 20 Grad versetzt ist.

23. Maschine nach Anspruch 20, wobei das Gestell die horizontale Basisplatte (170) und eine erste und eine zweite vertikale Seitenplatte (172), befestigt an den Enden der Basisplatte, umfasst, wobei das sich hin- und herbewegende Messer an die Basisplatte anschlägt und sich horizontal entlang der Oberfläche davon hin- und herbewegt. 5
24. Maschine nach Anspruch 21, wobei der Schneidenhalter (162) aus Aluminium hergestellt ist. 10
25. Maschine nach Anspruch 20, wobei das Gestell ein Paar von voneinander beabstandeten Führungsrollen (174) für das sich hin- und herbewegende Messer, umfassend eine Schneide (161), befestigt in einem Schneidenhalter (162), umfasst, wobei der Schneidenhalter einen Führungsarm (166) an einem Ende umfasst, wobei der Führungsarm zwischen den Rollen zum Führen des sich hin- und herbewegenden Messers positioniert ist. 15 20
26. Maschine nach Anspruch 1, die weiterhin eine Schlitzeinrichtungsanordnung aufweist, wobei die Schlitzeinrichtungsanordnung (107) eine Schlitzeinrichtungsschneide (110) umfasst, angeordnet parallel zu der Bahn zum Schneiden der Bahn vertikal entlang deren Kanten oder in eine Mehrzahl von Bahnen. 25
27. Maschine nach Anspruch 26, wobei die Schlitzeinrichtungsanordnung eine erste und eine zweite drehbare Welle umfasst, wobei die Bahn zwischen der ersten und der zweiten Welle hindurchführt, wobei die Schlitzeinrichtungsschneide auf der zweiten Welle so befestigt ist, um entlang der Länge davon bewegbar zu sein. 30 35
28. Maschine zum Herstellen einer fortlaufenden Wellenbahn, die aufweist: 40
 eine Schneidanordnung (154) zum aufeinanderfolgenden Schneiden einer Materialbahn, auf die ein Klebemittel in einer Mehrzahl von Streifen aufgebracht worden ist, wobei das Klebemittel bewirkt, dass die Mehrzahl der Streifen aneinander ankleben, um die fortlaufende Wellenbahn zu bilden; 45
 eine Ziehrollenanordnung (116) zum Ziehen der Materialbahn zu der Schneidanordnung hin; **gekennzeichnet dadurch, dass** die Schneidanordnung für ein aufeinanderfolgendes und kontinuierliches Schneiden der Bahn dient, dass die Ziehrollenanordnung für ein kontinuierliches Ziehen der Bahn dient, und dass 50
 ein gekrümmter Träger (124) zwischen der Ziehrollenanordnung (146) und der Schneidanordnung (154) vorgesehen ist, über den die Materialbahn kontinuierlich direkt in die Schneidanordnung hineinführt und intermittierend blasenartig läuft, damit die Materialbahn in die Schneidanordnung hinein federt.
29. Maschine nach Anspruch 28, die weiterhin eine federnde Anordnung (125) zum Drücken der Materialbahn zurück gegen den gekrümmten Träger (124) auf das blasenartige Laufen der Materialbahn hin von dem gekrümmten Träger weg aufweist.
30. Maschine nach Anspruch 29, wobei die federnde Anordnung (125) eine Mehrzahl von linienförmigen Anordnungen (143) umfasst, die angrenzend an den gekrümmten Träger positioniert sind, wobei die Materialbahn die linienförmigen Anordnungen während des blasenartigen Laufens der Materialbahn berührt und eine nach außen gerichtete Kraft ausübt, wodurch sich die linienförmigen Anordnungen nach außen bewegen, wobei sich die linienförmigen Anordnungen dann zusammenziehen und eine nach innen gerichtete Kraft auf die Materialbahn ausüben, um die Bahn zurück gegen den gekrümmten Träger zu drücken.
31. Maschine nach Anspruch 28, wobei die federnde Anordnung einen ersten, linienförmigen Balken (126), positioniert hinter der Ziehrollenanordnung, einen Federbalken (130), positioniert unterhalb der Ziehrollenanordnung, einen linienförmigen Führungsbalken (132), positioniert unterhalb des Federbalkens, und eine Mehrzahl erster linienförmiger Anordnungen (137) umfasst, wobei jede der ersten linienförmigen Anordnungen eine Feder (146) umfasst, die ein Ende mit dem Federbalken verbunden besitzt, und ein linienförmiges Teil umfasst, wobei das linienförmige Teil jeder der ersten linienförmigen Anordnungen ein Ende mit dem anderen Ende der Feder (140) verbunden besitzt und das andere Ende mit dem ersten linienförmigen Balken verbunden besitzt, wobei sich jedes der linienförmigen Teile nach unten von dem Federbalken um den linienförmigen Führungsbalken herum und dann nach oben über den gekrümmten Träger, dann unter der Ziehrollenanordnung zu dem ersten linienförmigen Balken (126) hin, erstreckt.
32. Maschine nach Anspruch 31, wobei der linienförmige Führungsbalken eine Mehrzahl von linienförmigen Führungen (138) umfasst, die sich entlang der Länge des Führungsbalkens in einer beabstandeten Beziehung erstrecken, wobei sich die linienförmigen Teile der ersten linienförmigen Anordnungen um die linienförmigen Führungen jeweils herumwickeln.
33. Maschine nach Anspruch 31, wobei die federnde Anordnung weiterhin einen zweiten linienförmigen

Balken (128), positioniert zwischen der Ziehrollen-anordnung und dem Federbalken, und eine Mehrzahl von zweiten linienförmigen Anordnungen, positioniert angrenzend an den gekrümmten Träger, umfasst, wobei jede der zweiten linienförmigen Anordnungen ein linienförmiges Teil umfasst, das sich zwischen dem ersten und dem zweiten linienförmigen Balken (126, 128) erstreckt, wobei die Materialbahn die Linien während eines blasenartigen Laufens der Materialbahn berührt und bewirkt, dass sich die linienförmigen Teile nach außen bewegen, wobei sich die linienförmigen Teile dann zusammenziehen und eine nach innen gerichtete Kraft auf die Materialbahn ausüben, um die Bahn zurück gegen den gekrümmten Träger zu drücken.

34. Maschine nach Anspruch 28, wobei die Schneidanordnung aufweist:

- a) eine Messeranordnung (156), angeordnet quer zu der Materialbahn zum Schneiden der Materialbahn horizontal entlang deren Breite in eine Mehrzahl von Streifen, wobei die Messeranordnung ein sich hin- und herbewegendes Messer (158) und ein stationäres Messer (160) umfasst;
- b) ein Gestell (168) zum Befestigen des sich hin- und herbewegenden Messers; und
- c) eine Nockenwellenanordnung (170), die betriebsmäßig der Messeranordnung zugeordnet ist, um eine horizontale sich hin- und herbewegende Scherenwirkung auf das sich hin- und herbewegende Messer auszuüben.

35. Maschine nach Anspruch 34, wobei das sich hin- und herbewegende Messer eine Schneide (161) besitzt, die in einem Schneidenhalter (162) befestigt ist, wobei der Schneidenhalter ein Paar von beabstandeten ersten Verbindungsstäben (164) an der Rückseite besitzt, wobei die Nockenwellenanordnung eine Nockenwelle umfasst, die ein Paar von beabstandeten zweiten Verbindungsstäben (187, 188) besitzt, verbunden mit dem Paar der ersten Verbindungsstäbe jeweils, wobei die Nockenwellenanordnung weiterhin einen ersten und einen zweiten Nocken (183, 184) umfasst, befestigt an der Nockenwelle für eine Drehung zusammen damit, wobei das Paar der zweiten Verbindungsstäbe auf dem ersten und dem zweiten Nocken jeweils befestigt ist, um die sich hin- und herbewegende Scherenwirkung auf das sich hin- und herbewegende Messer aufzubringen.

36. Maschine nach Anspruch 35, wobei der erste Nocken (173) zu dem zweiten Nocken (184) in einem Bereich zwischen ungefähr 15 bis 20 Grad versetzt ist.

37. Maschine nach Anspruch 34, wobei das Gestell eine horizontale Basisplatte (178) und eine erste und eine zweite vertikale Seitenplatte (172), befestigt an den Enden der Basisplatte, umfasst, wobei das sich hin- und herbewegende Messer an die Basisplatte anschlägt und sich horizontal entlang der Oberfläche davon hin- und herbewegt.

38. Maschine nach Anspruch 35, wobei der Schneidenhalter (162) aus Aluminium hergestellt ist.

39. Maschine nach Anspruch 34, wobei das Gestell ein Paar von voneinander beabstandeten Führungsrollen (174) das sich hin- und herbewegende Messer, umfassend eine Schneide (161), befestigt in einem Schneidenhalter, den Schneidenhalter umfassend, einen Führungsarm (166) an einem Ende umfasst, wobei der Führungsarm zwischen den Rollen zum Führen des sich hin- und herbewegenden Messers positioniert ist.

40. Maschine nach Anspruch 28, die weiterhin einen Packungstisch (178) zum Packen der Materialbahnen und einen Packungsbalken (179) zum Drücken der Materialbahnen auf den Packungstisch von der Schneidanordnung weg in eine anstoßende Beziehung zu zuvor geschnittenen Streifen auf dem Tisch aufweist, wobei das Klebemittel zuvor auf das Blattmaterial aufgebracht ist, was bewirkt, dass die Streifen aneinander anhaften, um dadurch eine fortlaufende Wabenbahn zu bilden.

41. Maschine nach Anspruch 40, wobei die Schneidanordnung ein sich hin- und herbewegendes Messer (158) umfasst, wobei der Packungsbalken (171) unterhalb des sich hin- und herbewegenden Messers angeordnet ist.

42. Maschine nach Anspruch 40, die weiterhin eine Einrichtung (208) zum Einstellen der Höhe des Packungstisches aufweist, um die Breite der geschnittenen Streifenbahnen zu variieren.

43. Maschine nach Anspruch 42, wobei die Einrichtung zum Einstellen der Höhe des Packungstisches einen pneumatischen Kolben (208) aufweist.

Revendications

1. Machine pour la production d'une bande continue en nid d'abeilles, comprenant :
 - une cage de laminage (22) pour supporter une pluralité de bobines de matériau en feuille (27), le matériau en feuilles étant déroulé de chacune des bobines pour former une pluralité de feuilles continues de matériau (30 à 35), cha-

- cune des feuilles possédant une première (42) et une seconde (44) face ;
- un premier poste (52) comprenant une pluralité d'ensembles de collecteur d'adhésif (73 à 77) pour appliquer des lignes espacées d'adhésif, de façon longitudinale, sur la première face des feuilles sélectionnées de matériau ;
 - un second poste (98) comprenant une pluralité de rouleaux espacés et parallèles (100 à 104) pour superposer et coller les feuilles de matériau ensemble afin de former une bande composite (232), la bande composite possédant une face interne (234) et une face externe (236) ;
 - un ensemble de collecteur de bande (112) pour appliquer des lignes d'adhésif sur la face externe de la bande composite ; et
 - un troisième poste (114) comprenant :
 - un ensemble de rouleaux de traction (116) pour tirer la bande ;
 - un ensemble de découpe (154) pour une découpe séquentielle de la bande en une pluralité de rubans de bande ;
 - un ensemble d'emballage (196) pour emballer des rubans découpés de bande en butée avec des rubans précédemment découpés de bande, les lignes d'adhésif précédemment appliquées à la face externe de la bande provoquant l'adhésion de la pluralité de rubans découpés de bande l'un sur l'autre, formant ainsi une bande continue en nid d'abeilles ;

caractérisée en ce que l'ensemble de rouleaux de traction (116) est prévu pour tirer en continu la bande et l'ensemble de découpe (154) est prévu pour découper, de façon successive et continue, la bande et **en ce qu'un** support incurvé (124) entre l'ensemble de rouleaux de traction et l'ensemble de découpe est prévu, la bande passant en continu vers le bas à partir de l'ensemble de rouleau de traction dans l'ensemble de découpe et cloquant, de façon intermittente, sur le support incurvé afin de faire rebondir la bande dans l'ensemble de découpe.

2. Machine selon la revendication 1, dans laquelle la cage de laminoir (22) comprend un cadre (24) possédant une pluralité d'arbres espacés et parallèles (28) montés pour une rotation, les bobines étant montées sur les axes respectifs de bobine (28), chacun des axes de bobine comprenant un frein pneumatique (46) pour faire varier la vitesse à laquelle le matériau en feuilles se déroule des bobines, le cadre comprenant des pièces tubulaires creuses (25) à travers lesquelles passe de l'air sous pression, les freins étant connectés, de façon fonc-

tionnelle, aux pièces tubulaires pour le transfert de l'air sous pression des pièces tubulaires vers les freins (46).

3. Machine selon la revendication 2, comprenant, de plus, une pluralité de conduites d'air (50) pour transférer l'air des pièces tubulaires vers chacun des freins, une extrémité de chacune des conduites d'air étant connectée aux pièces tubulaires et l'autre extrémité de chacune des conduites d'air étant connectée respectivement à chacun des freins.

4. Machine selon la revendication 1, dans laquelle le premier poste comprend :

a) un cadre possédant une plate-forme (60) et une pièce de cadre supérieur (58), la pluralité d'ensembles de collecteur d'adhésif (73 à 77) étant positionnés le long de la longueur du cadre et étant fixés transversalement à la pièce de cadre supérieur de façon espacée et parallèle ; et

b) une pluralité de premiers ensembles de rouleaux de freinage (64 à 68) le long de la plate-forme du cadre, les ensembles de rouleaux de freinage étant espacés, de façon parallèle, le long de la longueur de la plate-forme (60), chacun des ensembles de rouleaux de freinage étant aligné de façon à peu près coplanaire avec chacun des ensembles de collecteur de feuilles sur la pièce de cadre supérieur, les feuilles sélectionnées de matériau étant respectivement alimentées à travers les premiers ensembles de rouleaux de freinage puis, de façon globalement verticale, vers le haut devant un ensemble respectif de collecteur de feuilles dans lequel les lignes d'adhésif sont appliquées sur la première face de chacune des feuilles sélectionnées de matériau.

5. Machine selon la revendication 4, dans laquelle chacun des ensembles de rouleaux de freinage possède des premier, second et troisième rouleaux rotatifs allongés et parallèles, les feuilles sélectionnées de matériau s'enveloppant autour des premier, second et troisième arbres (69, 70, 72) des ensembles respectifs de rouleau de freinage.

6. Machine selon la revendication 4, dans laquelle la plate-forme comprend un plancher comprenant une pluralité de panneaux amovibles (62) pour permettre un accès aux ensembles de rouleaux de freinage.

7. Machine selon la revendication 4, dans laquelle la plate-forme comprend un plancher comprenant une pluralité de fentes, la pluralité de feuilles de matériau traversant respectivement la pluralité de fen-

tes.

8. Machine selon la revendication 4, comprenant, de plus, un second ensemble de rouleaux de freinage (92), fixé au sommet de la pièce de cadre supérieur (58), une des feuilles de matériau étant fournie à travers le second ensemble de rouleaux de freinage. 5
9. Machine selon la revendication 8, dans laquelle le second ensemble de rouleaux de freinage comprend des premier et second rouleaux rotatifs allongés et parallèles, une des feuilles de matériau traversant les premier et second rouleaux. 10
10. Machine selon la revendication 4, dans laquelle chacun des ensembles de collecteur d'adhésif comprend : 15
 - a) des première et seconde barres allongées et parallèles (78, 79) s'étendant transversalement à la pièce de cadre supérieur (58) ; et 20
 - b) un collecteur allongé d'adhésif s'étendant transversalement à la pièce de cadre supérieur, le collecteur étant espacé des première et seconde barres et étant fixé à la première barre, la feuille de matériau étant fournie entre les première et seconde barres et le collecteur. 25
11. Machine selon la revendication 10, dans laquelle chacun des collecteurs d'adhésif comprend un tube creux (82) à travers lequel s'écoule de l'adhésif, le tube possédant une pluralité de trous espacés sur sa longueur, l'adhésif traversant les trous pour passer sur la première face de la feuille de matériau, passant en face des collecteurs respectifs et formant dessus ainsi des lignes parallèles d'adhésif. 30 35
12. Machine selon la revendication 11, dans laquelle les trous des collecteurs sélectionnés sont décalés des trous des autres collecteurs sélectionnés. 40
13. Machine selon la revendication 4, comprenant, de plus, un ensemble de filtres d'adhésif (88) connectés, de façon fonctionnelle, à chacun des ensembles de collecteur d'adhésif pour filtrer l'adhésif. 45
14. Machine selon la revendication 10, dans laquelle chacun des collecteurs d'adhésif est réalisé en cuivre. 50
15. Machine selon la revendication 1, dans laquelle le premier poste comprend un cadre (24) possédant une pièce de cadre supérieur (58), le second poste (98) comprenant la pluralité de rouleaux (100 à 104) fixés au sommet de la pièce de cadre supérieur (58), les rouleaux étant positionnés le long du cadre de façon transversale, espacée et parallèle à la pièce 55

ce du cadre supérieur, les rouleaux étant globalement alignés, de façon coplanaire, au-dessus des ensembles respectifs de collecteur d'adhésif et des feuilles sélectionnées de matériau passant respectivement autour des rouleaux, les feuilles de matériau étant disposées, de façon globalement horizontale, au-dessus desdits rouleaux et superposées l'une à l'autre, la première face des feuilles de matériau adhérant respectivement la seconde face des feuilles de; matériau pour former la bande composite.

16. Machine selon la revendication 1, comprenant, de plus, un ensemble de rouleaux de compression (105) entre le premier poste et l'ensemble de rouleaux de traction (116) pour la compression de la bande composite.
17. Machine selon la revendication 16, dans laquelle l'ensemble de rouleaux de compression (105) comprend des premier et second rouleaux rotatifs allongés et adjacents (100, 106), la bande passant entre les premier et second rouleaux afin de comprimer la bande.
18. Machine selon la revendication 1, comprenant, de plus, un ensemble de tension sous ressort (125) pour ramener la bande contre la surface du support incurvé (124) en réponse au bullage de la bande à l'écart de la surface du support incurvé, l'ensemble de tension sous ressort comprenant une première barre linéaire (126) placée derrière l'ensemble de rouleaux de traction, une barre à ressorts (130) placée en dessous de l'ensemble de rouleau de traction, une barre de guidage linéaire (132) placée en dessous de la barre à ressorts (130) et une pluralité de premiers ensembles de ligne (138), chacun des premiers ensembles de ligne comprenant un ressort (140) possédant une extrémité raccordée à la barre à ressorts et à une ligne, la ligne de chacun des premiers ensembles de ligne possédant une extrémité raccordée à l'autre extrémité du ressort et l'autre extrémité raccordée à la première barre linéaire, chacune des lignes s'étendant vers le bas à partir de la barre à ressorts autour de la barre de guidage puis vers le haut au-dessus du support incurvé puis sous l'ensemble de rouleaux de traction en direction de la première barre linéaire.
19. Machine selon la revendication 18, dans laquelle l'ensemble de tension à ressort (125) comprend, de plus, une seconde barre linéaire (128, 132) placée entre l'ensemble de rouleaux de traction et la barre à ressorts, et une pluralité de seconds ensembles de ligne (143) placés adjacents au support incurvé, chacun des seconds ensembles de ligne comprenant une ligne (143a) s'étendant derrière l'ensemble de rouleaux de traction entre les première et se-

conde barres de ligne, la bande étant en contact avec les lignes pendant le bullage de la bande et provoquant un déplacement vers l'extérieur des lignes, les lignes se contractant alors et exerçant un effort vers l'intérieur sur la bande pour ramener la bande contre le support incurvé.

20. Machine selon la revendication 1, dans laquelle l'ensemble de découpe comprend :

- a) un ensemble de lame de coupe (156) placé transversalement à la bande pour découper la bande à l'horizontal selon sa largeur en une pluralité de rubans de bande, l'ensemble de lame de coupe comprenant une lame à déplacement alternatif (158) et une lame fixe (160) ;
- b) un cadre (168) comprenant une plaque horizontale de base (170) pour le montage de la lame à déplacement alternatif, la lame à déplacement alternatif se déplaçant en butée et de façon alternée le long de la surface de la plaque de base ; et
- c) un ensemble d'arbre à cames (176) associé, de façon fonctionnelle, à l'ensemble de lame de coupe pour appliquer une action de cisaillement alternatif horizontal à la lame à déplacement alternatif.

21. Machine selon la revendication 20, dans laquelle la lame à déplacement alternatif possède une lame (161) montée dans un support de lame (162), le support de lame possédant une paire de premières bielles espacées (164) à l'arrière, l'ensemble d'arbre à cames comprenant un arbre à cames (182) possédant une paire de seconde bielles espacées (187, 188) respectivement couplées à la paire de premières bielles, l'ensemble d'arbre à cames comprenant, de plus, des première et seconde cames (183, 184) montées, de façon rotative, sur l'arbre à cames, la paire de secondes cames comprenant chacune une extrémité entourant respectivement les première et seconde cames pour fournir une action de cisaillement alterné à la lame à déplacement alternatif.

22. Machine selon la revendication 21, dans laquelle la première came (183) est décalée de la seconde came (184) d'un intervalle d'environ 15 à 20°.

23. Machine selon la revendication 20, dans laquelle le cadre comprend la plaque horizontale de base (170) et des première et seconde plaques latérales verticales (172) fixées aux extrémités de la plaque de base, la lame à déplacement alternatif étant en butée contre la plaque de base et se déplaçant, de façon alternée, à l'horizontal le long de sa surface.

24. Machine selon la revendication 21, dans laquelle le

support de lame (162) est réalisé en aluminium.

25. Machine selon la revendication 20, dans laquelle le cadre comprend une paire de galets de guidage espacés (174), la lame à déplacement alternatif comprenant une lame (161) montée dans un support de lame (162), le support de lame comprenant un bras de guidage (166) à une extrémité, le bras de guidage étant positionné entre les galets pour un guidage de la lame à déplacement alternatif.

26. Machine selon la revendication 1, comprenant, de plus, un ensemble de refente, l'ensemble de refente (107) comprenant une lame de refente (110) disposée parallèle à la bande pour découper la bande à la verticale selon ses bords ou en une pluralité de bandes.

27. Machine selon la revendication 26, dans laquelle l'ensemble de refente comprend des premier et second arbres rotatifs, la bande passant entre les premier et second arbres, la lame de refente étant montée sur le second arbre de façon à pouvoir se déplacer sur sa longueur.

28. Machine pour la production d'une bande continue en nid d'abeilles, comprenant :

- un ensemble de découpe (154) pour découper, de façon séquentielle, une feuille de matériau sur laquelle est appliqué un adhésif selon une pluralité de rubans, l'adhésif provoquant l'adhésion de la pluralité de rubans l'un sur l'autre pour former la bande continue en nid d'abeilles ;
- un ensemble de rouleaux de traction (116) pour tirer la feuille de matériau vers l'ensemble de découpe ;

caractérisée en ce que l'ensemble de découpe est prévu pour découper, de façon séquentielle et continue, la bande, **en ce que** l'ensemble de rouleaux de traction est prévu pour tirer en continu la bande et

en ce qu'un support incurvé (124) entre l'ensemble de rouleaux de traction (146) et l'ensemble de découpe (154) est prévu sur lequel la feuille de matériau passe en continu directement dans l'ensemble de découpe et, de façon intermittente, cloque pour projeter la feuille de matériau dans l'ensemble de découpe.

29. Machine selon la revendication 28, comprenant, de plus, un ensemble de tension à ressort (125) pour pousser la feuille de matériau contre le support incurvé (124) en réponse au bullage de la feuille de matériau à l'écart du support incurvé.

30. Machine selon la revendication 29, dans laquelle l'ensemble de tension à ressort (125) comprend une pluralité d'ensembles de ligne (143) positionnés adjacents au support incurvé, la feuille de matériau étant en contact et exerçant une force vers l'extérieur sur les ensembles de ligne lors d'un bullage de la feuille de matériau, provoquant un déplacement vers l'extérieur des ensembles de ligne, les ensembles de ligne se contractant alors et exerçant une force vers l'intérieur sur la feuille de matériau pour ramener la bande contre le support incurvé.
31. Machine selon la revendication 28, dans laquelle l'ensemble de tension à ressort comprenant une première barre linéaire (126) placée derrière l'ensemble de rouleaux de traction, une barre à ressorts (130) placée en dessous de l'ensemble de rouleaux de traction, une barre de guidage linéaire (132) placée en dessous de la barre à ressorts (130) et une pluralité de premiers ensembles de ligne (137), chacun des premiers ensembles de ligne comprenant un ressort (146) possédant une extrémité raccordée à la barre à ressorts et à une ligne, la ligne de chacun des premiers ensembles de ligne possédant une extrémité raccordée à l'autre extrémité du ressort (140) et l'autre extrémité raccordée à la première barre linéaire, chacune des lignes s'étendant vers le bas à partir de la barre à ressorts autour de la barre de guidage linéaire puis vers le haut au-dessus du support incurvé puis sous l'ensemble de rouleau de traction en direction de la première barre linéaire (126).
32. Machine selon la revendication 31, dans laquelle la barre de guidage linéaire comprend une pluralité de guides de ligne (138) s'étendant le long de la barre de guidage de façon espacée, les lignes des premiers ensembles de ligne entourant respectivement les guides de ligne.
33. Machine selon la revendication 31, dans laquelle l'ensemble de tension à ressort comprend, de plus, une seconde barre linéaire (128) placée entre l'ensemble de rouleaux de traction et la barre à ressorts et une pluralité de seconds ensembles de ligne placés adjacents au support incurvé, chacun des seconds ensembles de ligne comprenant une ligne s'étendant entre les première et seconde barres linéaires (126, 128), la feuille de matériau étant en contact avec les lignes lors d'un bullage de la feuille de matériau et provoquant un déplacement vers l'extérieur des lignes, les lignes se contractant alors et exerçant un effort vers l'intérieur sur la feuille de matériau pour ramener la bande contre le support incurvé.
34. Machine selon la revendication 28, dans laquelle l'ensemble de découpe comprend :
- a) un ensemble de lame de coupe (156) placé transversalement à la feuille de matériau pour découper la feuille de matériau à l'horizontale selon sa largeur en une pluralité de rubans de bande, l'ensemble de lame de coupe comprenant une lame à déplacement alternatif (158) et une lame fixe (160) ;
 - b) un cadre (168) pour le montage de la lame à déplacement alternatif ; et
 - c) un ensemble d'arbre à cames (170) associé, de façon fonctionnelle, à l'ensemble de lame de coupe pour appliquer une action de cisaillement alternatif horizontal à la lame à déplacement alternatif.
35. Machine selon la revendication 34, dans laquelle la lame à déplacement alternatif possède une lame (161) montée dans un support de lame (162), le support de lame possédant une paire de premières bielles espacées (164) à l'arrière, l'ensemble d'arbre à cames comprenant un arbre à cames possédant une paire de seconde bielles espacées (187, 188) respectivement couplées à la paire de premières bielles, l'ensemble d'arbre à cames comprenant, de plus, des première et seconde cames (183, 184) montées, de façon rotative, sur l'arbre à cames, la paire de secondes cames étant supportées respectivement sur des première et seconde cames pour fournir une action de cisaillement alterné à la lame à déplacement alternatif.
36. Machine selon la revendication 35, dans laquelle la première came (173) est décalée de la seconde came (184) d'un intervalle d'environ 15 à 20°.
37. Machine selon la revendication 34, dans laquelle le cadre comprend une plaque horizontale de base (178) et des première et seconde plaques latérales verticales (172) fixées aux extrémités de la plaque de base, la lame à déplacement alternatif étant en butée contre la plaque de base et se déplaçant, de façon alternée, à l'horizontale le long de sa surface.
38. Machine selon la revendication 35, dans laquelle le support de lame (162) est réalisé en aluminium.
39. Machine selon la revendication 34, dans laquelle le cadre comprend une paire de galets de guidage espacés (174), la lame à déplacement alternatif comprenant une lame montée dans un support de lame, le support de lame comprenant un bras de guidage (166) à une extrémité, le bras de guidage étant positionné entre les galets pour un guidage de la lame à déplacement alternatif.
40. Machine selon la revendication 28, comprenant, de plus, une table d'emballage (178) pour emballer les rubans de matériau et une barre d'emballage (179)

pour pousser les rubans de matériau sur la table d'emballage à l'écart de l'ensemble de découpe en butée avec des rubans précédemment découpés sur la table, l'adhésif précédemment appliqué à la feuille de matériau provoquant une adhésion des rubans l'un sur l'autre, formant ainsi une bande continue en nid d'abeilles. 5

41. Machine selon la revendication 40, dans laquelle l'ensemble de découpe comprend une lame à déplacement alternatif (158), la barre d'emballage (171) étant montée en dessous de la lame à déplacement alternatif. 10

42. Machine selon la revendication 40, comprenant, de plus, un moyen (208) pour régler la hauteur de la table d'emballage afin de faire varier la largeur des rubans découpés de bande. 15

43. Machine selon la revendication 42, dans laquelle le moyen de réglage de la hauteur de la table d'emballage comprend un vérin pneumatique (208). 20

25

30

35

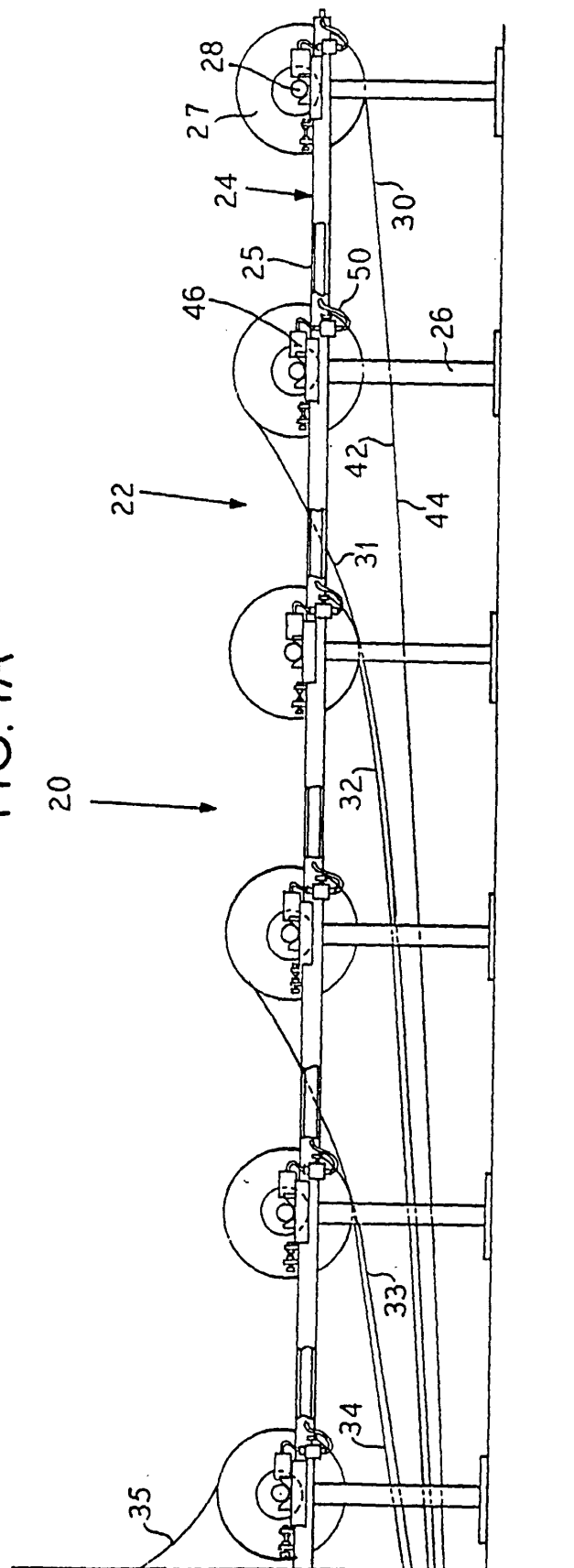
40

45

50

55

FIG. 1A



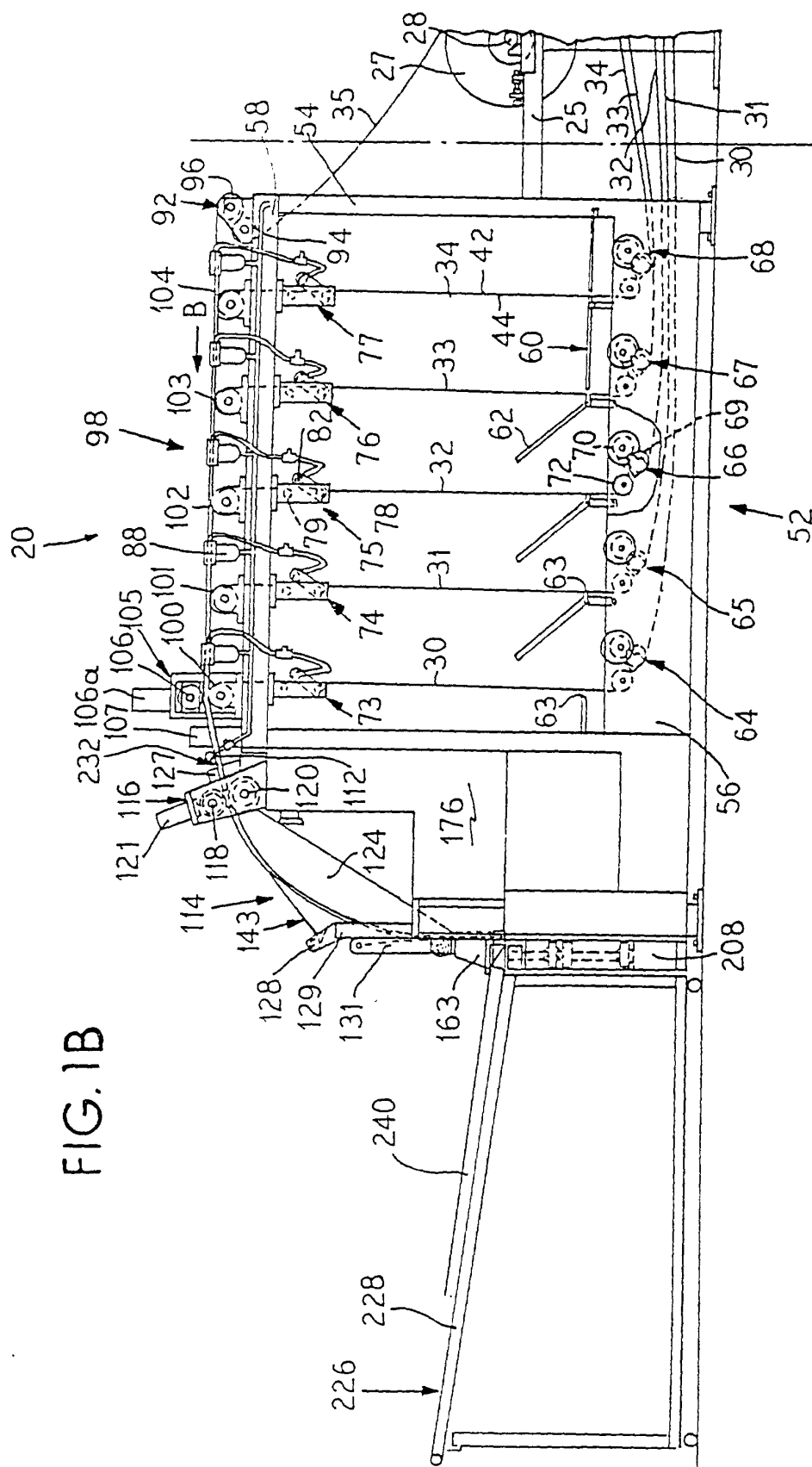
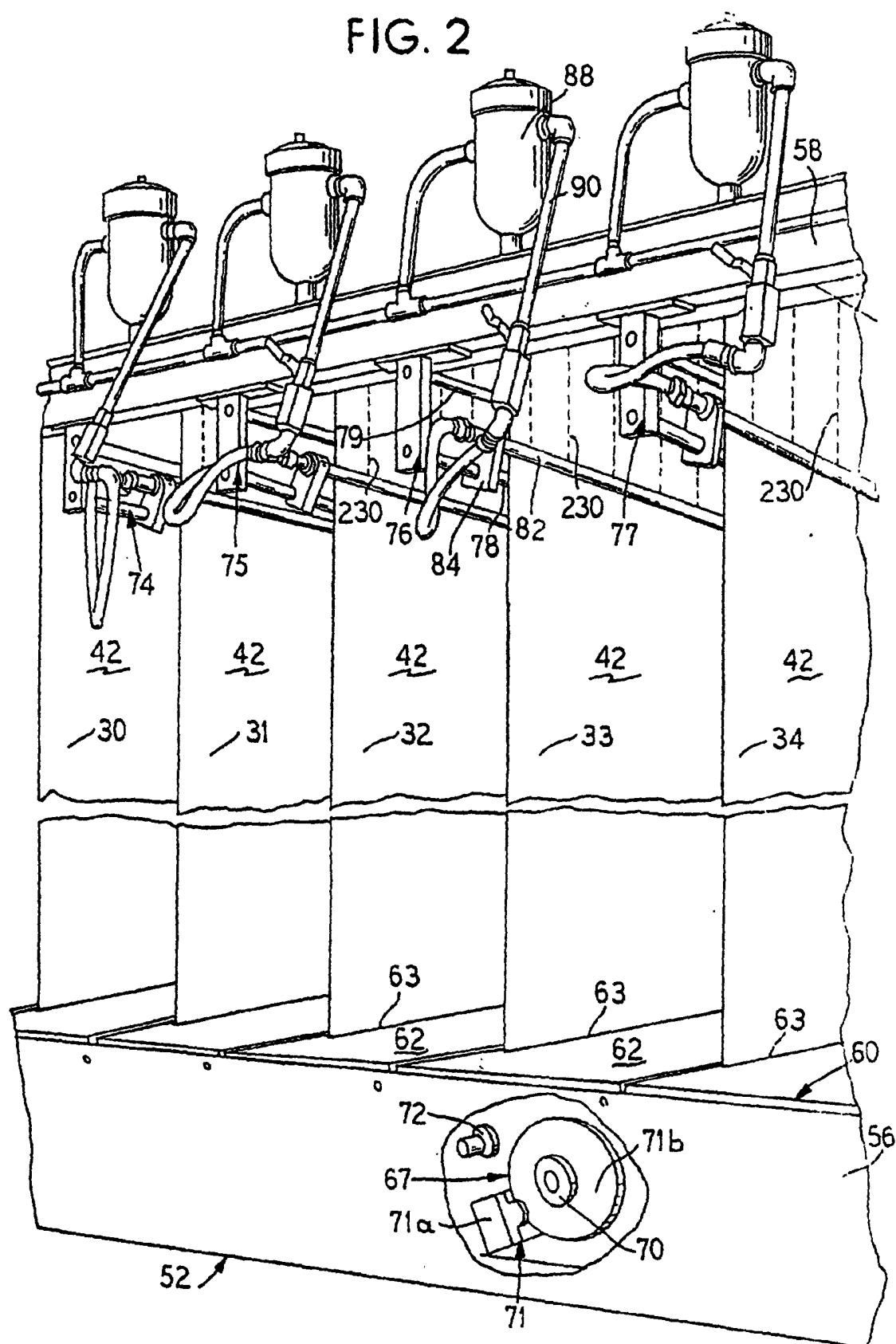


FIG. 2



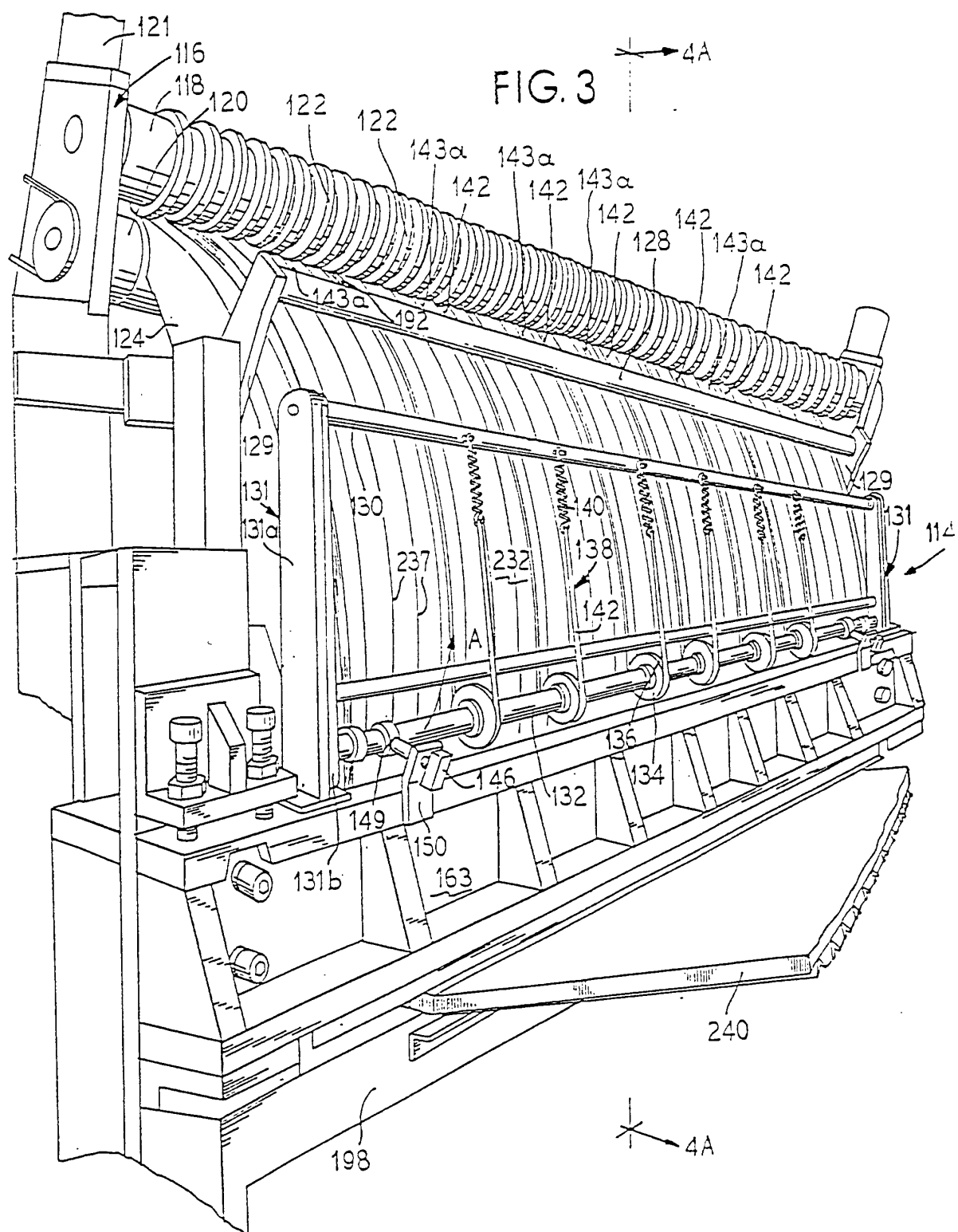
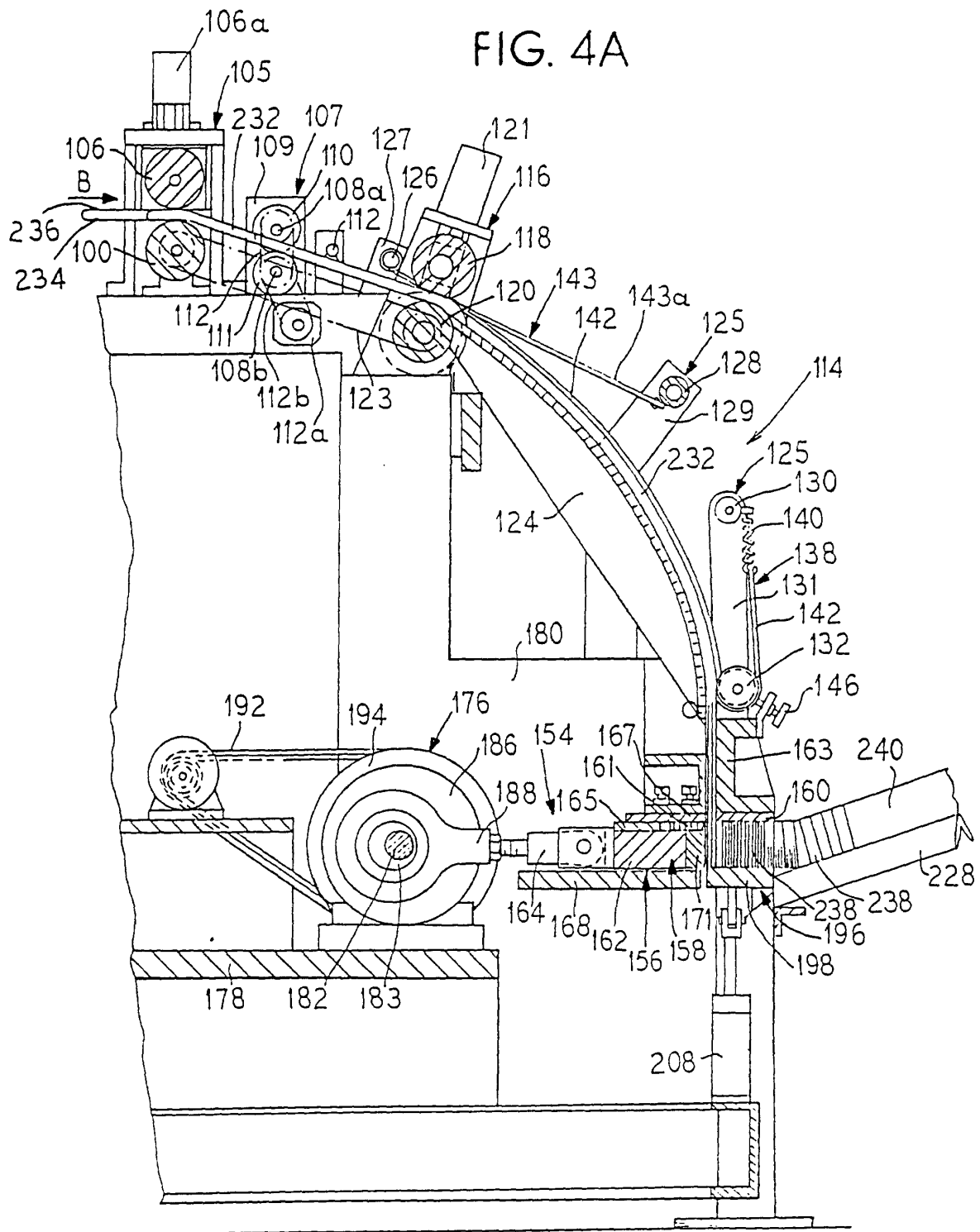
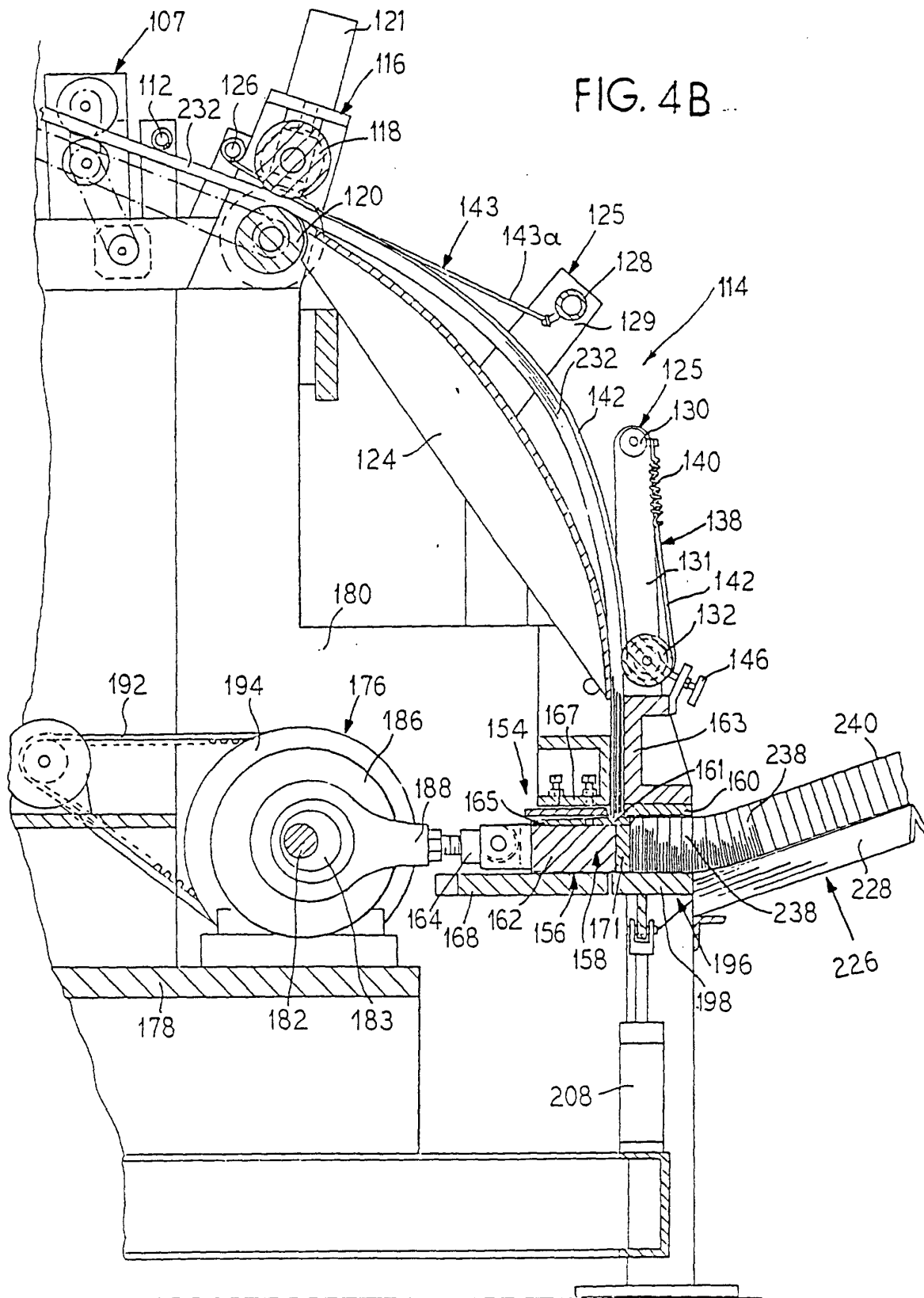
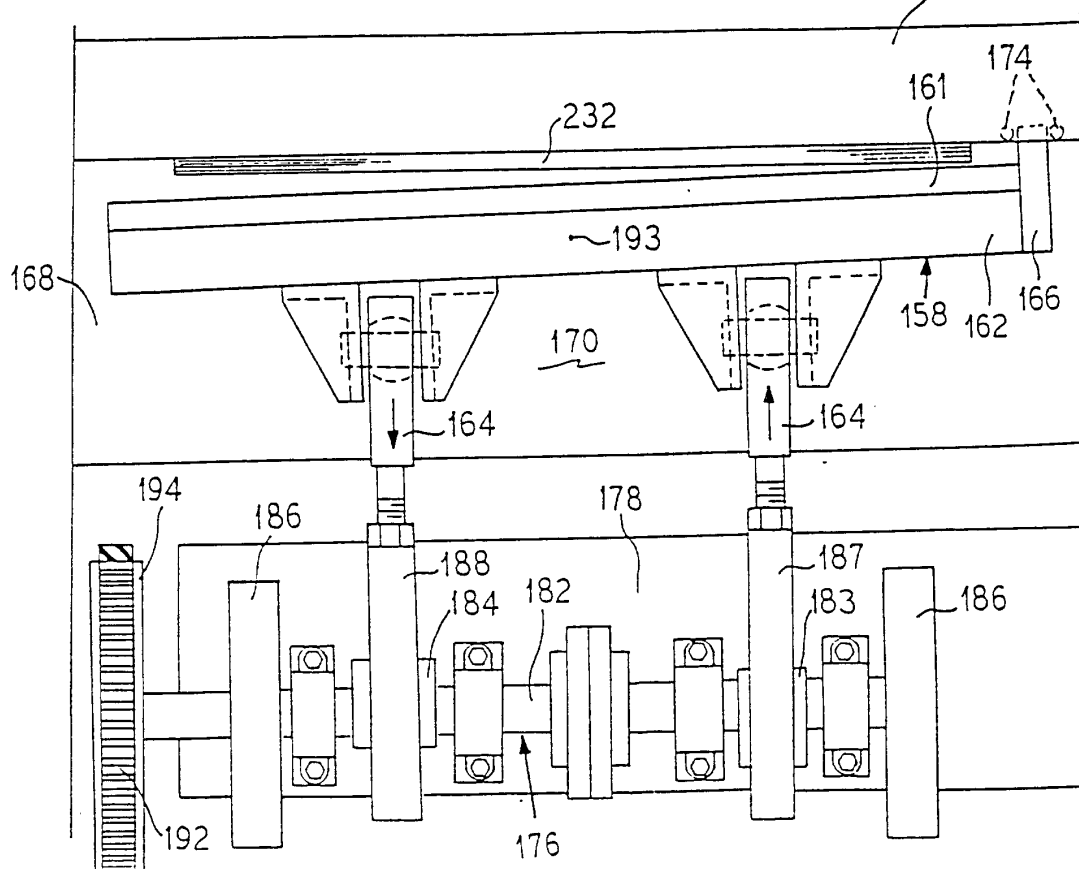
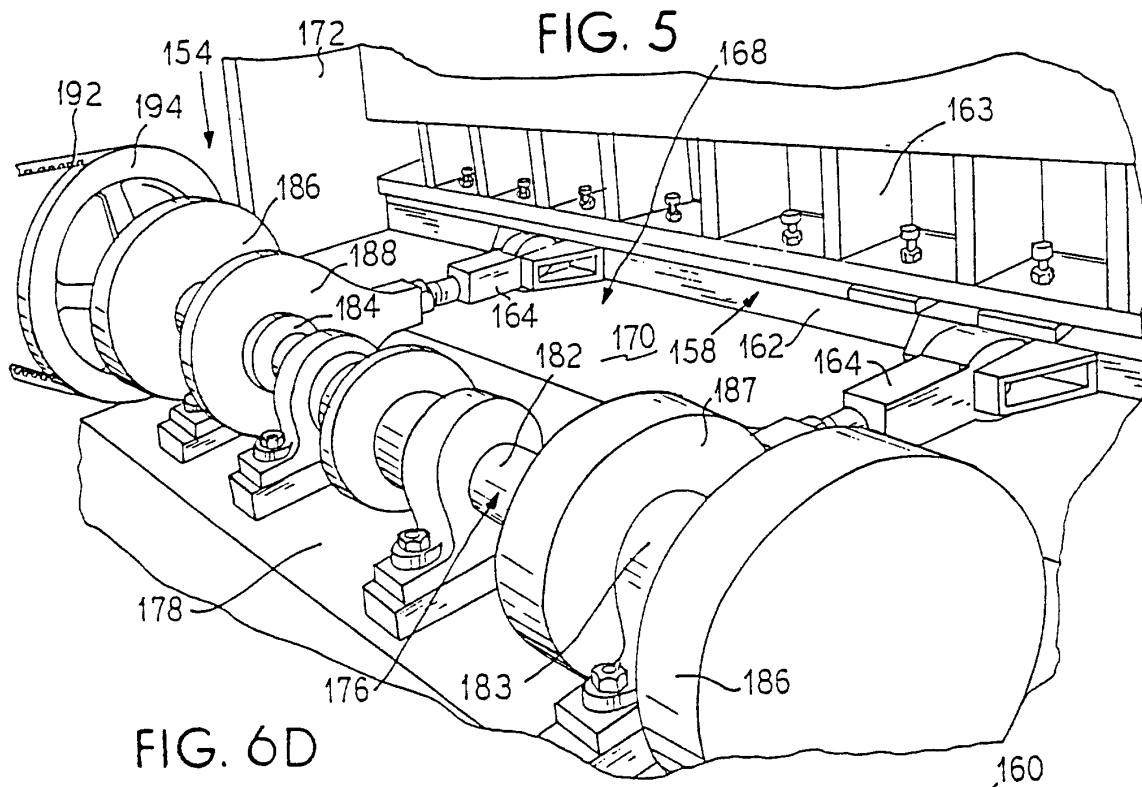


FIG. 4A







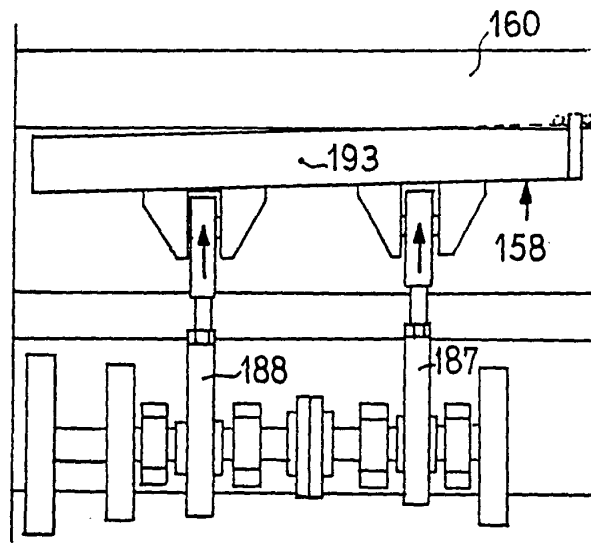


FIG. 6A

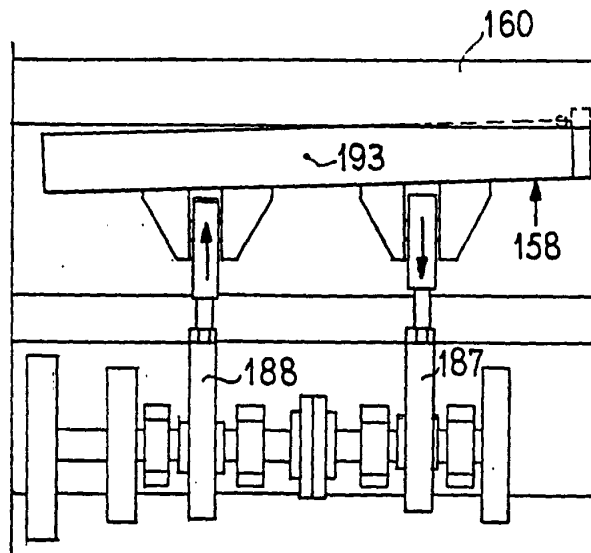


FIG. 6B

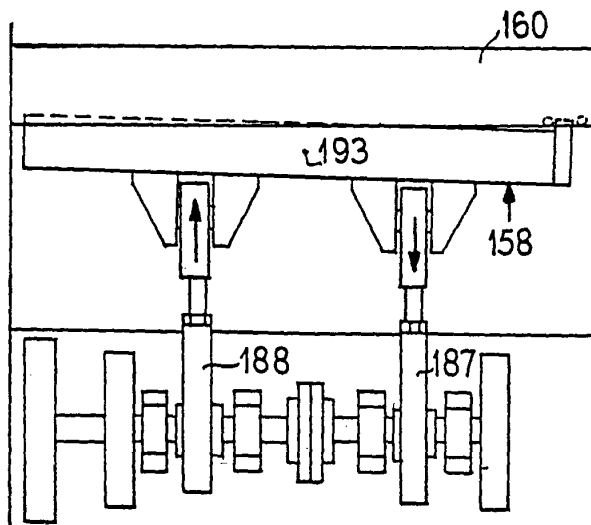


FIG. 6C