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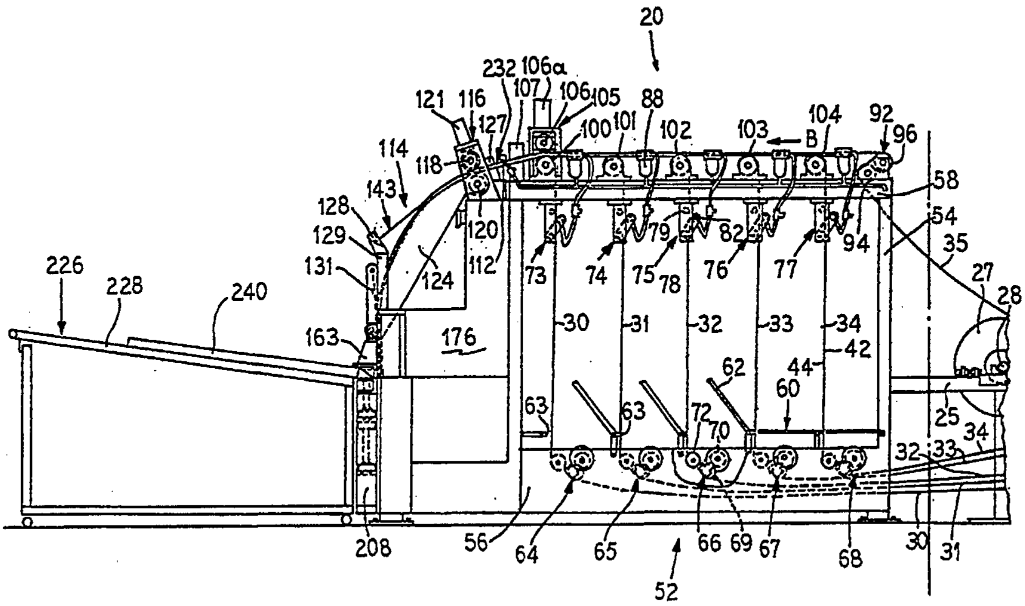

(57) Abstract

A machine (20) for the production of a continuous web of honeycomb material (240) comprising a cutting assembly (154) for successively and continuously cutting a sheet of material (27) to which adhesive (230) has been applied into a plurality of strips (238), the adhesive (230) causing the plurality of strips (238) to adhere to each other to form the continuous honeycomb web (240). The sheet of material (27) continuously passes and intermittently bubbles over a curved support (124). A springing assembly (125) urges the sheet of material (27) back against the curved support (124) in response to bubbling of the sheet of material (27) away from the curved support (124).

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MACHINE FOR MAKING HONEYCOMB MATERIAL

Technical Field

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

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

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 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.

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.

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.

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 changeover 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.

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.

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.

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

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.

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.

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.

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.

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

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

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.

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.

The sheet material is unwound from each of the rolls 28 to form a plurality of continuous sheets of material 30-35 having a first face 42 and a second face 44.

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.

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.

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.

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 3). 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.

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.

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 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.

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.

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.

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.

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 108a, supplies the rotary slitter motion to the shafts 108a and 108b and thus to the slitter blade 110 and roll guide 111, respectively.

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.

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 positioned and spaced along the length thereof. Each of the ribs 122 extend around the circumference of 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 106 thereby connecting the pull roll assembly 116 and the compression roller assembly 106 for coupled rotation.

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.

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.

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.

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 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.

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 120 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.

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 128. 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 alternatingly disposed with respect to each other in the area defining the upper end portion of support 124.

The third station 114 further includes a pair of knobs 146 which are secured, adjacent the line guide 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 structure associated with the third station 114 without interference by the spring line assemblies 138.

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 6A). 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.

Referring to FIGURE 5, the reciprocating knife 158 is mounted on a frame 168 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.

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.

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 surround cams 183 and 184 respectively. The other end of connecting rods 187 and 188 is coupled to the end of connecting rods 164 of the blade holder 163. 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.

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.

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.

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).

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.

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.

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.

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

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 in the direction of arrow A towards sheet manifold assemblies 73-77, respectively.

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.

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.

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.

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 236. 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.

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.

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 edges of web 232 may be cut by the slitter blade 110. According 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.

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.

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 adhesive 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.

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.

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.

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.

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.

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).

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.

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 128 and a tendency for the bubble to bubble a greater distance away from the surface of support 128 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.

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.

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.

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.

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.

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.

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 86 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.

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.

WHAT IS CLAIMED IS:

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

a) a roll stand for supporting a plurality of rolls of sheet material, the sheet material being unwound from each of the rolls to form a plurality of continuous sheets of material, each of the sheets having a first and second face;

b) a first station including a plurality of adhesive manifold assemblies for applying spaced apart lines of adhesive longitudinally on the first face of selected sheets of material;

c) a second station for superimposing and adhering the sheets of material together to form a composite web, the composite web having an inner face and an outer face;

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

e) a third station including:

a pull roll assembly for continuously pulling the web;

a cutting assembly for successively and continuously cutting the web into a plurality of web strips;

a packing assembly 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; and

a curved support, the web continuously passes downwardly and intermittently bubbling over the curved support.

2. The machine of claim 1, wherein the roll stand includes a frame having a plurality of spaced and parallel shafts mounted thereon for rotation, the rolls being mounted on the roll shafts respectively, each of the roll shafts including a brake for varying the speed at which the sheet material unwinds from the rolls.

3. The machine of claim 2, wherein each of the brakes is a pneumatic brake.

4. The machine of claim 3, wherein the frame includes hollow tube members 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.

5. The machine of claim 4, further comprising a plurality of air lines 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.

6. The machine of claim 1, wherein the first station includes:

a) a frame having a deck and an upper frame member, the plurality of adhesive manifold assemblies being positioned along the length of the frame and being secured to the upper frame member in spaced and parallel relation transverse thereto; and

b) a plurality of first brake roller assemblies along the deck of the frame, the brake roller assemblies being spaced in parallel relation along the length of the deck, 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.

7. The machine of claim 6, 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 of the brake roller assemblies, respectively.

8. The machine of claim 6, wherein the deck comprises a floor including a plurality of removable panels for allowing access to the brake roller assemblies.

9. The machine of claim 6, wherein the deck comprises a floor including a plurality of slits, the plurality of sheets of material passing through the plurality of slits, respectively.

10. The machine of claim 6, further comprising a second brake roller assembly secured to the top of the upper frame member, one of the sheets of material being fed through the second brake roller assembly.

11. The machine of claim 10, 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 shafts.

12. The machine of claim 6, wherein each of the adhesive manifold assemblies comprises:

a) first and second parallel elongate bars extending transversely to the upper frame member; 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.

13. The machine of claim 12, wherein each of the adhesive manifolds comprises a hollow tube 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.

14. The machine of claim 13, wherein the holes of selected manifolds are offset from the holes in other selected manifolds.

15. The machine of claim 6, further comprising an adhesive filter assembly operatively connected to each of the adhesive manifold assemblies for filtering the adhesive.

16. The machine of claim 12, wherein each of the adhesive manifolds is made of copper.

17. The machine of claim 1, wherein the first station includes a frame having an upper frame member, the second station including a plurality of rollers secured to the top of the upper frame member, the rollers being positioned along the frame in spaced and parallel relation transverse to the upper frame member, the rollers being located 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 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.

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

19. The machine of claim 18, wherein the compression roller assembly includes first and second elongate and adjacent rotatable rollers, the web passing between the first and second rollers to compress the web.

20. The machine of claim 1, wherein the pull roll assembly includes first and second elongate and adjacent rotatable rollers, the first and second rollers

being parallel and adjacent to each other, the web being pulled through and between the first and second rollers towards the cutting assembly.

21. The machine of claim 20, wherein each of the rollers includes a plurality of ribs spaced along the length thereof, the ribs contacting the web when the web is pulled through the first and second rollers, the lines of adhesive on the outer face of the composite web passing between the ribs.

22. The machine of claim 1, further comprising a springing assembly for urging the web back against the surface of the curved support in response to bubbling of the web away from the surface of the curved support.

23. The machine of claim 22, wherein the springing assembly includes a plurality of line assemblies positioned adjacent the curved support, the web contacting and exerting an outward force to the line assemblies during bubbling of the web causing the line assemblies to move outwardly, the line assemblies then contracting and exerting an inward force to the web to urge the web back against the curved support.

24. The machine of claim 23, wherein the springing assembly further includes a first line bar positioned behind the pull roll assembly, a spring bar positioned below the pull roll assembly, a line guide bar positioned below the spring bar, and a plurality of first line assemblies, each of the first line assemblies including a spring 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 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.

25. The machine of claim 24, wherein the line guide bar includes a plurality of line guides extending the length of the guide bar in spaced relation, the lines of the first line assemblies wrapping around the line guides, respectively.

26. The machine of claim 24, wherein the springing assembly further includes a second line bar 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, 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 support.

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

a) a knife assembly 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 and a stationary knife;

b) a frame for mounting the reciprocating knife; and

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

28. The machine of claim 27, wherein the reciprocating knife has a blade mounted in a blade holder, the blade holder having a pair of spaced first connecting rods at the rear, the camshaft assembly including a camshaft having a pair of spaced second connecting rods coupled to the pair of first connecting rods respectively, the camshaft assembly further including first and second cams mounted on the camshaft for rotation therewith, the pair of second

connecting rods being supported on the first and second cams respectively for providing the reciprocating scissors action to the reciprocating knife.

29. The machine of claim 28, wherein the first cam is offset from the second cam in a range between approximately 15 to 20 degrees.

30. The machine of claim 27, wherein the frame includes a horizontal base plate and first and second vertical side plates secured to the ends of the base plate, the reciprocating knife abutting the base plate and reciprocating horizontally along the surface thereof.

31. The machine of claim 28, wherein the blade holder is made of aluminum.

32. The machine of claim 27, wherein the frame includes a pair of spaced apart guide rollers, the reciprocating knife including a blade mounted in a blade holder, the blade holder including a guide arm at one end, the guide arm being positioned between the rollers for guiding the reciprocating knife.

33. The machine of claim 1, wherein the packing assembly includes a packing table for packing cut web strips, a packing bar for pushing cut web strips on the table away from the cutting assembly into abutting relation with previously cut web strips, and means for adjusting the height of the packing table to vary the width of the web strips.

34. The machine of claim 33, wherein the means for adjusting the height of the packing table comprises a pneumatic jack.

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

36. The machine of claim 35, 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.

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

a) 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; and

b) a curved support over which the sheet of material continuously passes and intermittently bubbles.

38. The machine of claim 37, further comprising a springing assembly for urging the sheet of material back against the curved support in response to bubbling of the sheet of material away from the curved support.

39. The machine of claim 38, wherein 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 web back against the curved support.

40. The machine of claim 39, wherein the springing assembly includes a first line bar positioned behind the pull roll assembly, a spring bar positioned below the pull roll assembly, a line guide bar positioned below the spring bar, and a plurality of first line assemblies, each of the first line assemblies including a spring 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 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.

41. The machine of claim 40, wherein the line guide bar includes a plurality of line guides extending the length of the guide bar in spaced relation, the lines of the first line assemblies wrapping around the line guides, respectively.

42. The machine of claim 40, wherein the springing assembly further includes a second line bar 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, 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.

43. The machine of claim 37, wherein the cutting assembly comprises:

a) 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;

b) a frame for mounting the reciprocating knife; and

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

44. The machine of claim 43, wherein the reciprocating knife has a blade mounted in a blade holder, the blade holder having a pair of spaced first connecting

rods at the rear, the camshaft assembly including a camshaft having a pair of spaced second connecting rods coupled to the pair of first connecting rods respectively, the camshaft assembly further including first and second cams 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.

45. The machine of claim 44, wherein the first cam is offset from the second cam in a range between approximately 15 to 20 degrees.

46. The machine of claim 43, wherein the frame includes a horizontal base plate and first and second vertical side plates secured to the ends of the base plate, the reciprocating knife abutting the base plate and reciprocating horizontally along the surface thereof.

47. The machine of claim 44, wherein the blade holder is made of aluminum.

48. The machine of claim 43, wherein the frame includes a pair of spaced apart guide rollers, the reciprocating knife including a blade mounted in a blade holder, the blade holder including a guide arm at one end, the guide arm being positioned between the rollers for guiding the reciprocating knife.

49. The machine of claim 37, further comprising 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 the sheet of material causing the strips to adhere to each other thereby forming a continuous honeycomb web.

50. The machine of claim 49, wherein the cutting assembly includes a reciprocating knife, the packing bar being mounted below the reciprocating knife.

51. The machine of claim 49, further comprising means for adjusting the height of the packing table to vary the width of the cut web strips.

52. The machine of claim 51, wherein the means for adjusting the height of the packing table comprises a pneumatic jack.

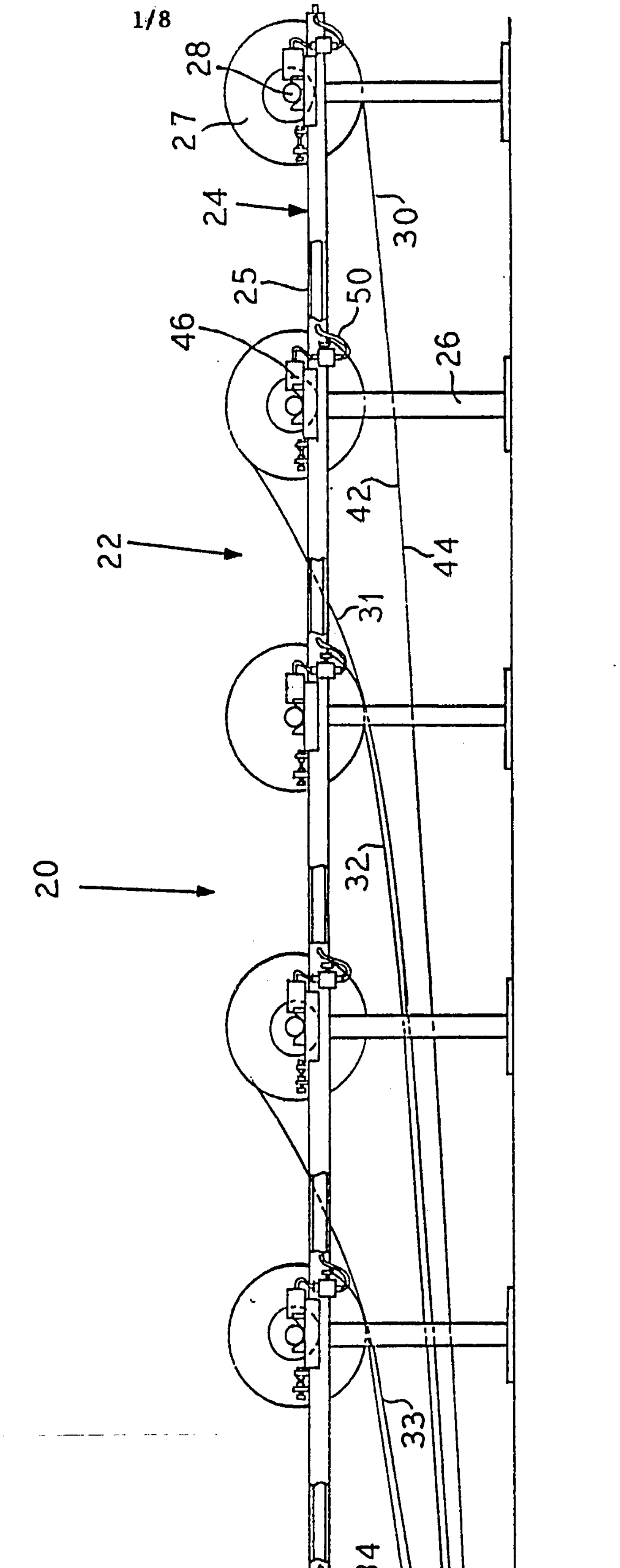


FIG. 1A

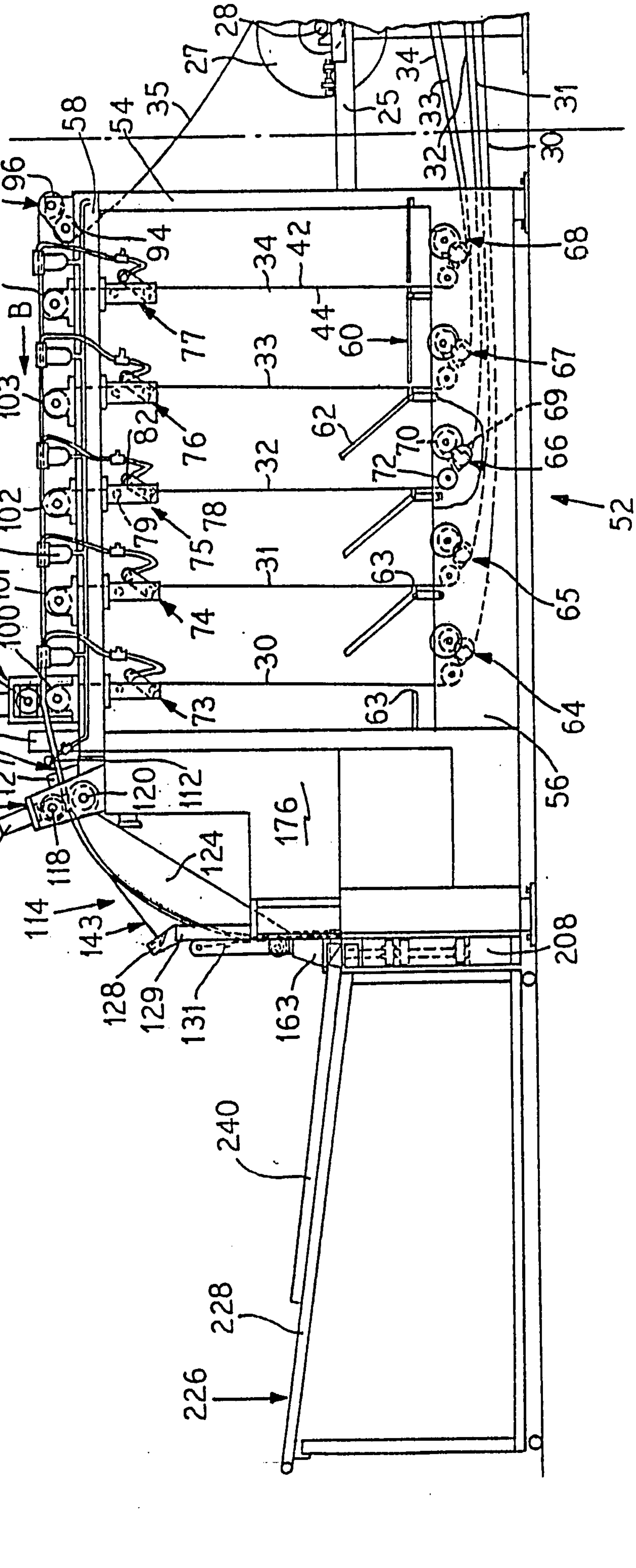
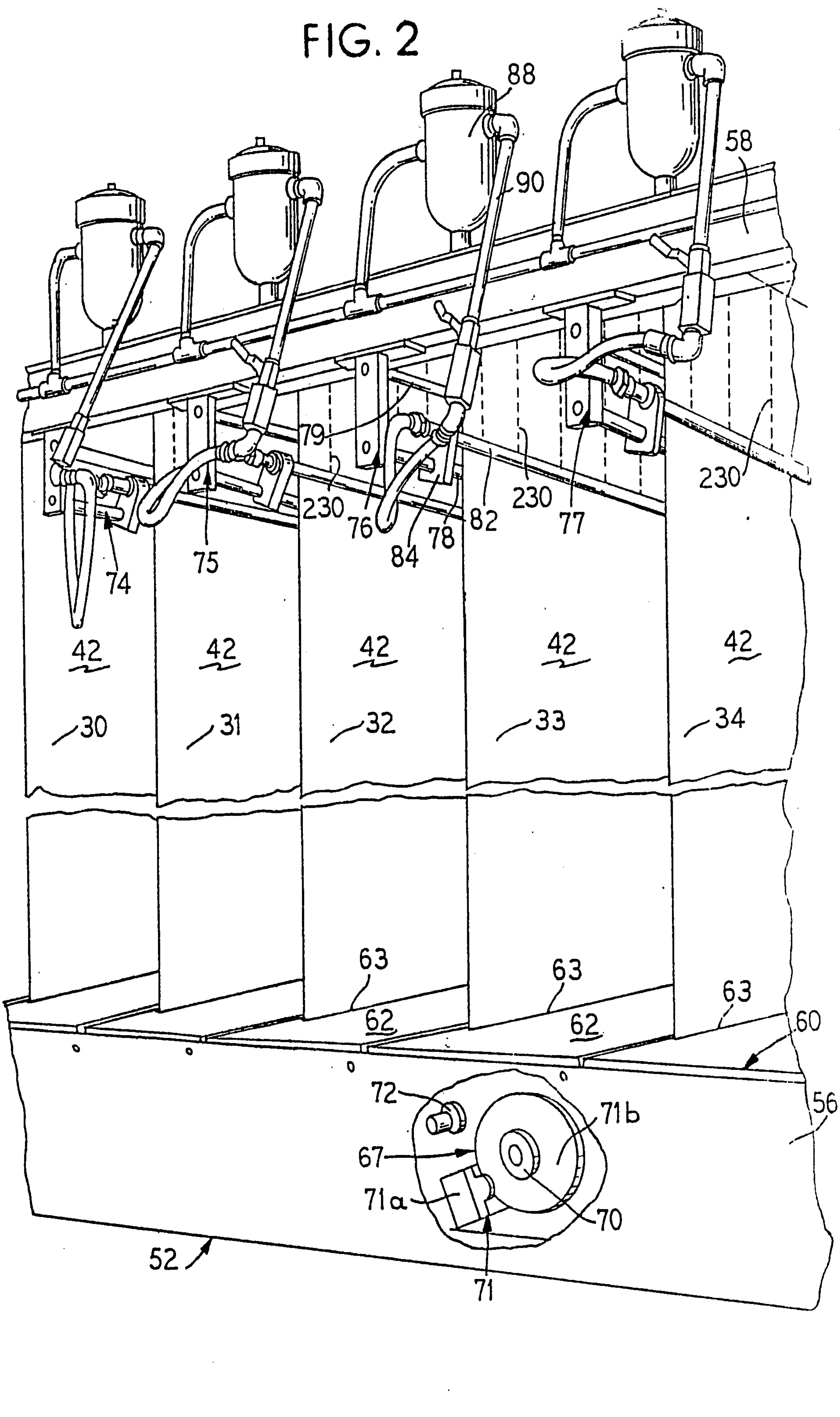


FIG. 1B

FIG. 2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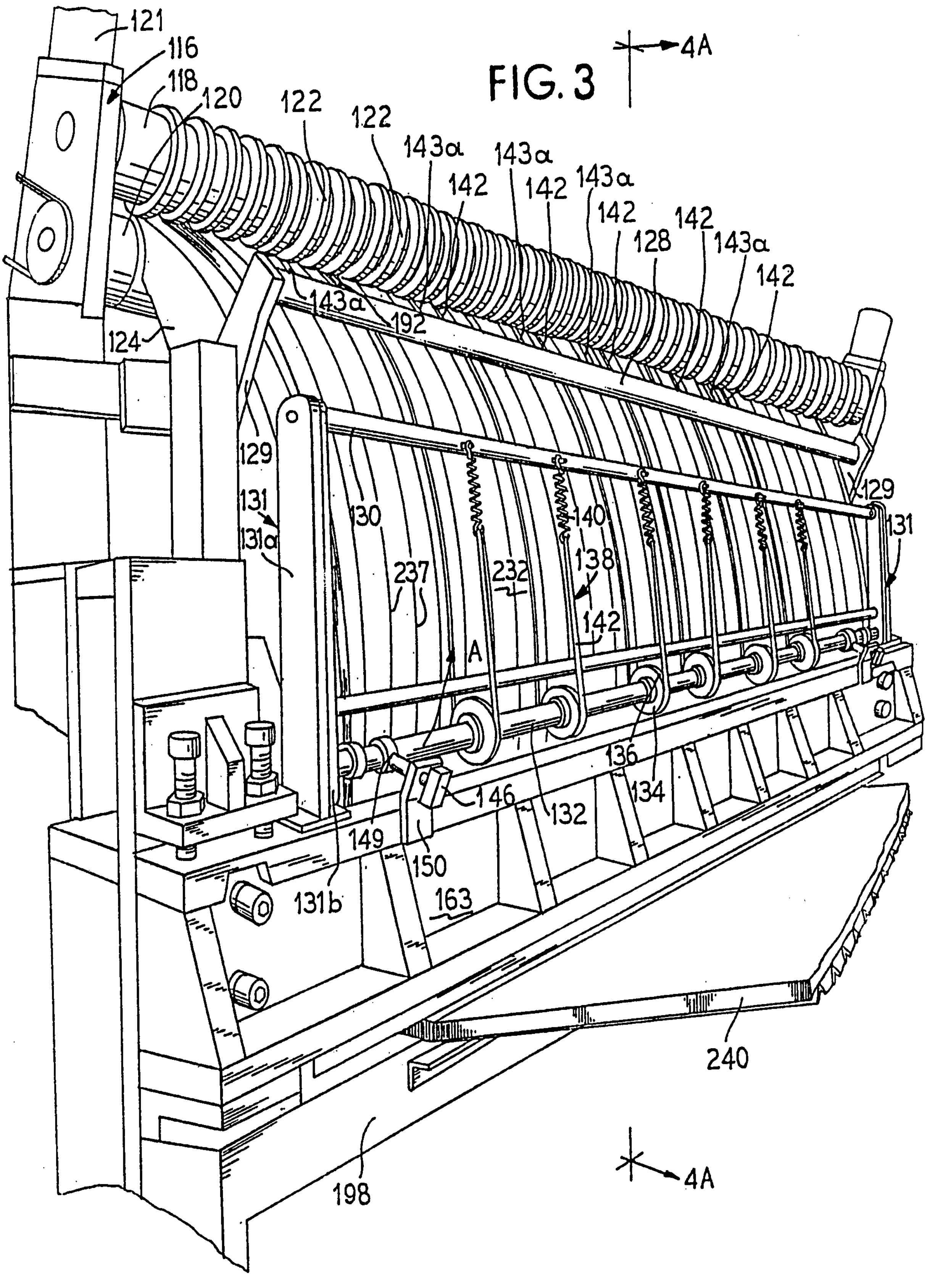
71b
67
71a
70
71
52


121
116
118
120
122
122
143a
143a
143a
142
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143a
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143a
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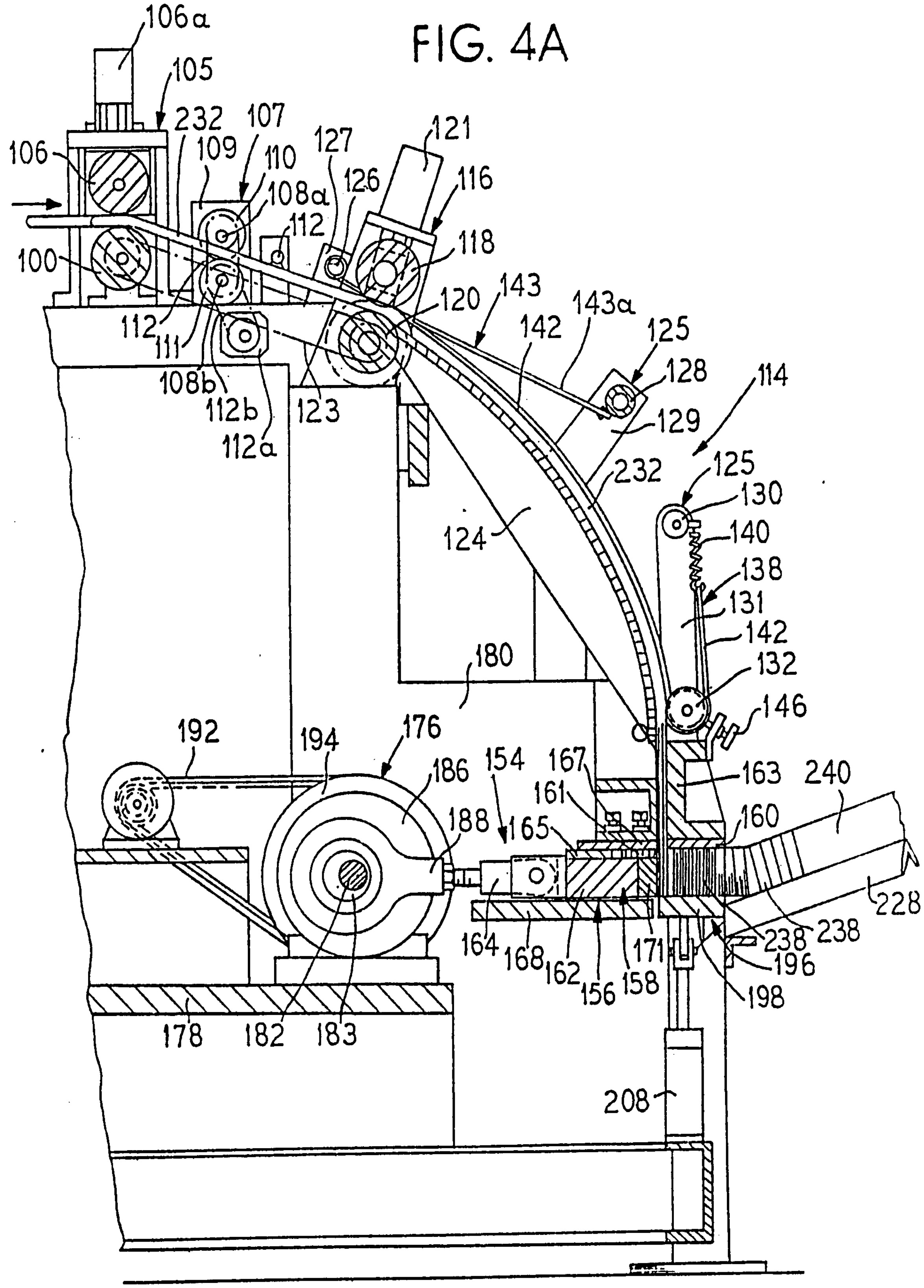
129
131
131a
130
140
138
232
237
142
A
136
134
146
132
149
150
131b
163
131
240
198
4A
4A

FIG. 3

FIG. 4A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232
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116
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142
112
111
128
108b
114
112b
123
129
112a
125
232
130
124
140
138
131
142
180
132
192
176
146
194
186
154
167
163
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158
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198
178
182
183
208

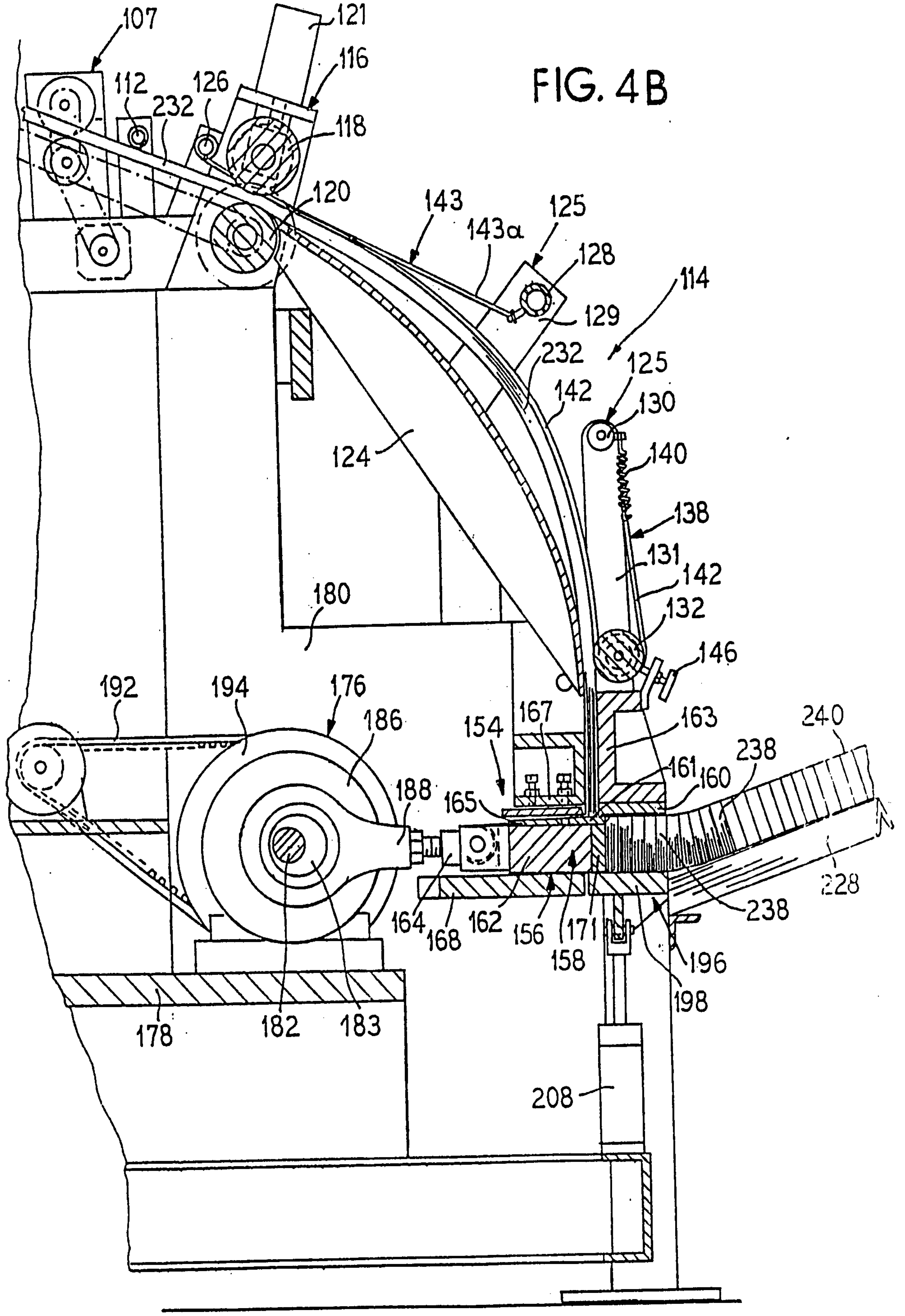
FIG. 4B
107
121
116
112
232
126
118
120
143
143a
125
128
129
114
232
125
130
142
124
140
138
131
142
132
180
146
192
194
176
186
167
154
163
240
238
161
160
165
188
228
238
164
168
162
156
158
171
196
198
178
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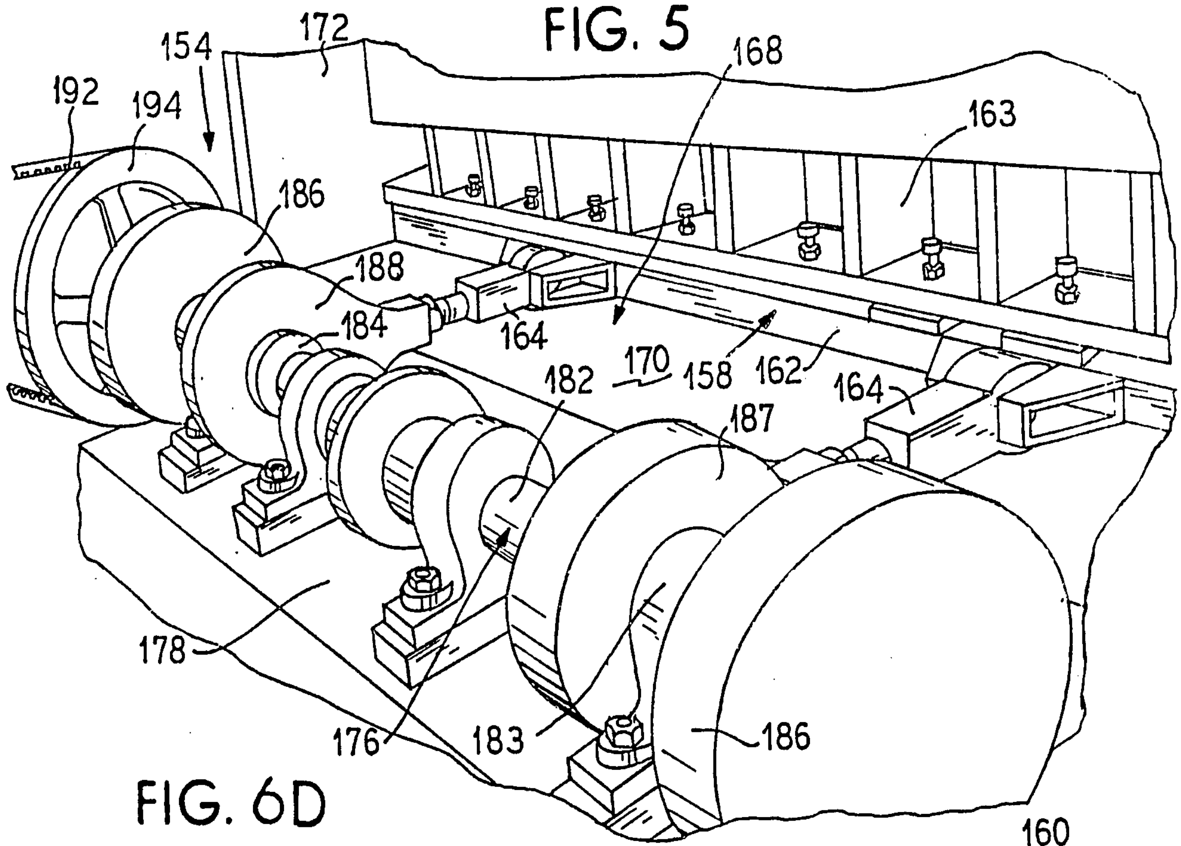
183
208

FIG. 5


172
154
168
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186
188
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170
158
162
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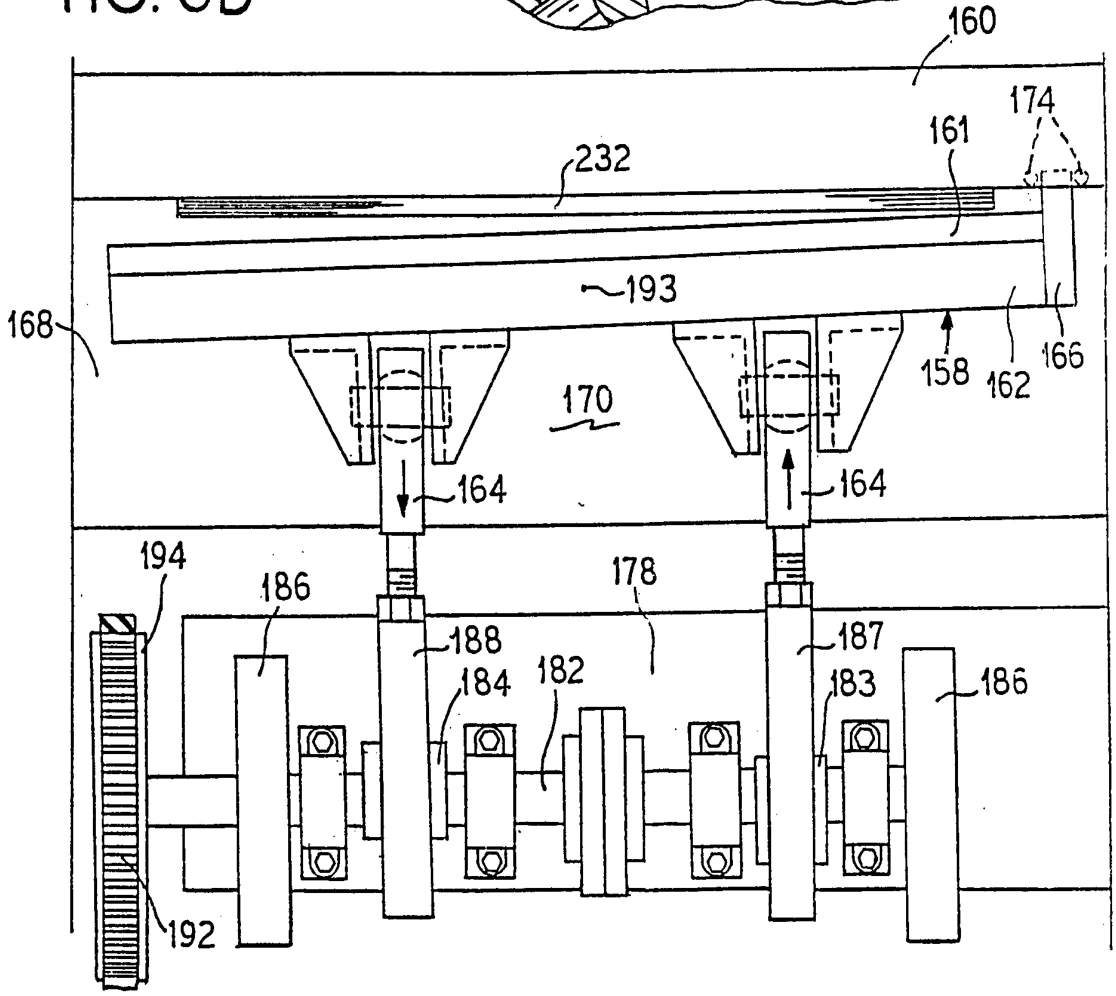
178
176
183
186

FIG. 6D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174
232
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164
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186
192

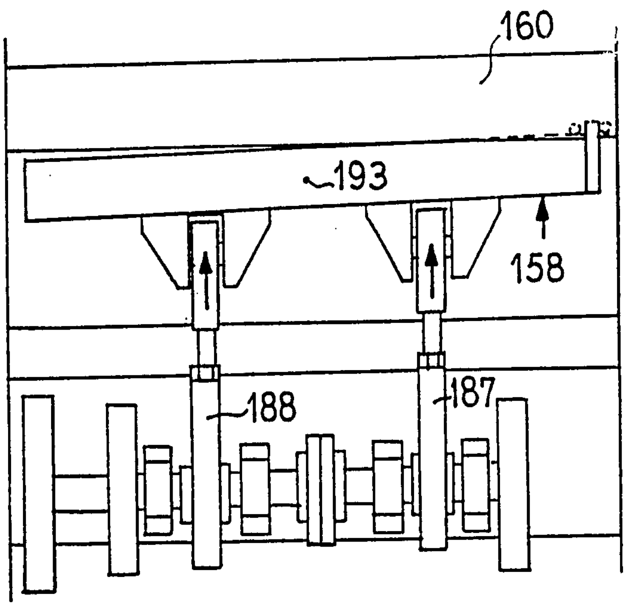

FIG. 6A

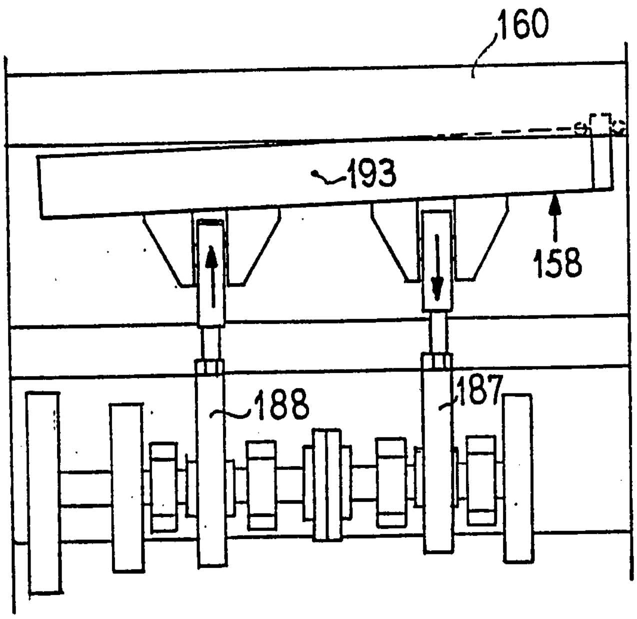

FIG. 6B

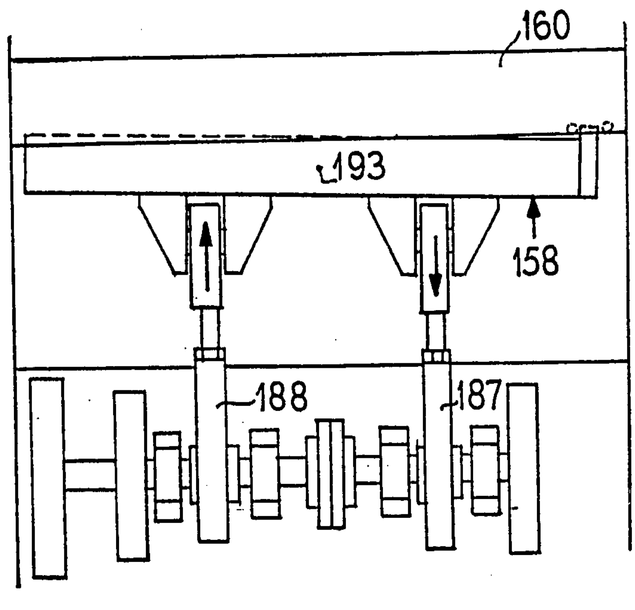

FIG. 6C

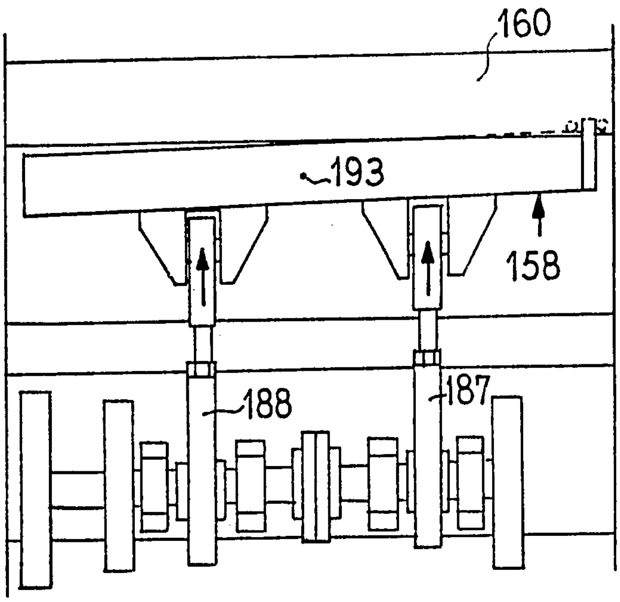

FIG. 6A

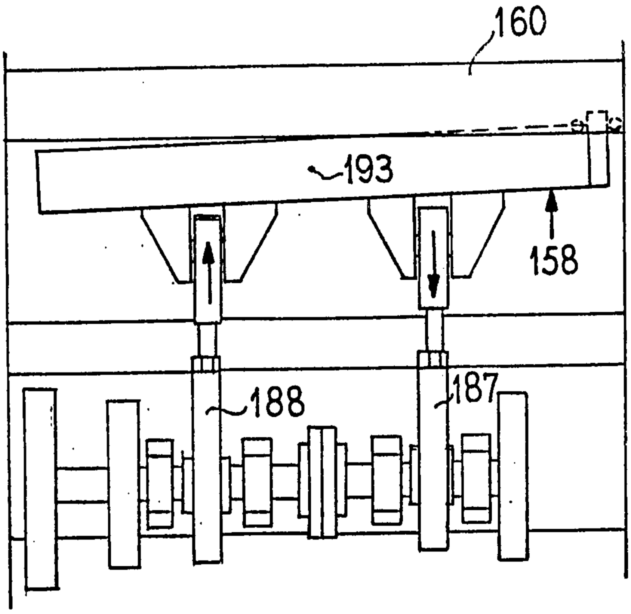

FIG. 6B

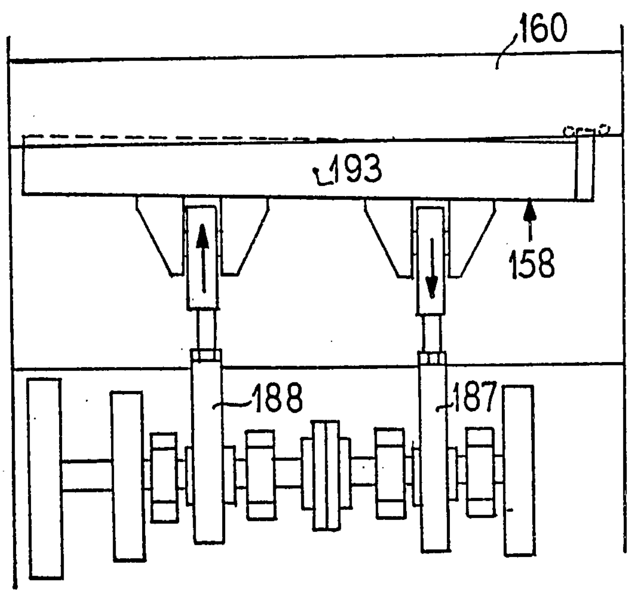

FIG. 6C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/07150

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B32B 31/00
US CL :156/361, 512, 517, 538, 548, 556, 558, 578
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 156/361, 512, 517, 538, 548, 556, 558, 578, 197, 256, 264, 269, 290

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,133,712 (GESCHWENDER) 09 JANUARY 1979, col. 3, lines 65-68, col. 4, lines 7-11 and 35-68, col 5, lines 1-2, 35-46, and 55-63, col. 6, lines 26-32, col. 9, lines 24-41 and 64-68.	1-52
Y	US, A, 3,416,983 (STEELE) 17 DECEMBER 1968, col. 5, lines 24-51, col. 6, lines 38-61.	1, 12-14, 27-32, 43-48
Y	US, A, 3,257,253 (HOYT) 21 JUNE 1966, col. 8, line 58 - col. 9, line 46.	1, 22-26, 37-42
Y	US, A, 3,979,252 (HOYT) 07 SEPTEMBER 1976, col. 6, lines 25-29.	2-5
Y	US, A, 5,062,919 (McPHERSON ET AL.) 05 NOVEMBER 1991, col. 5, lines 3-13.	15

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
21 September 1994

Date of mailing of the international search report
05 OCT 1994

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/07150

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 3,035,952 (GWYNNE) 22 MAY 1962, col. 4, lines 64-68.	18
Y	US, A, 3,770,549 (CARBONE) 06 NOVEMBER 1973, col. 3, line 61 - col. 4, line 6.	21
Y	US, A, 3,637,448 (SIEGAL ET AL.) 25 JANUARY 1972, col. 9, lines 40-69.	27-32, 43-48
Y	US, A, 3,741,840 (BOOTH) 26 JUNE 1973, col. 4, line 69 - col. 5, line 21.	35-36