

MULTIPLE CELL HONEYCOMB INSULATING PANEL

The present invention relates to multiple cell honeycomb insulating and shade panels. US-A-4631217 and 4631108 describe expandable and contractible honeycomb panels including an essentially vertical run of parallel elongate tubular cells, the cells extending transversely of the row, the cells being formed of a foldable, creasable material in the form of superposed strips. The panel is supported at its top and includes, usually, a bottom rail, so that the panel can be used, for example, as a blind of which the bottom rail can be raised and lowered. Such a blind has good insulating properties.

According to the present invention there is proposed an expandable and contractible honeycomb panel including a plurality of parallel laterally adjacent longitudinally extending rows of elongate tubular cells, the cells extending transversely of said rows in common directions normal to the relative lateral positioning of said rows, with the tubular cells of each row being offset longitudinally relative to the tubular cells of each adjacent row of tubular cells, said cells being constructed of a foldable, creasable and drapable material in the form of superposed material strips, each including a centre web extending longitudinally of the material strip and opposite side longitudinal marginal flaps folded inwardly into lapped relation with corresponding side portions of said centre web, the free edge of at least one of said flaps being bonded to an associated opposing portion of said centre web and each said material strip including at least two laterally spaced and longitudinally extending bond lines along which said material strip is bonded to opposing narrow zones of at least one adjacent strip, said material strips each forming one cell in one of said rows of cells and at least approximately three-quarters of at least one cell in

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another row of cells.

The multiple cell honeycomb insulating and shade panel of the invention (primarily to be used as a vertical panel and to be supported from the upper margin thereof),
5 has substantially identically appearing opposite sides which are gracefully creased and folded to provide an aesthetically pleasing appearance.

The invention further provides a support system for supporting a vertically disposed multi cell panel
10 including at least one row of vertically superposed, horizontal tubular cells, said support system including an elongate support strip and an opposing elongate stiffening strip, at least one of said strips including headed
15 projections projecting toward the other strip and the other strip including openings formed therethrough registered with said projections and into which said projections may be inserted and retentively retained by the heads thereon, said
stiffening member being adapted to be inserted into an upper
20 cell of said multi cell panel after which, by movement of said strips toward each other, said projections may pierce upper wall portions of the cell containing said stiffening strip and be projected into said openings.

In order that the present invention may more readily be understood, the following description is given,
25 merely by way of example, reference being made to the accompanying drawings in which:-

Figure 1 is a fragmentary, schematic vertical sectional view illustrating a first embodiment of double cell row panel constructed in accordance with the present
30 invention;

Figure 2A is a schematic sectional view showing the manner of folding a length of material to produce the panel of Figure 1;

Figures 2B and 2C are similar views illustrating
35 two different ways which the folded material is to be glued;

Figure 3 is a vertical sectional view showing a second embodiment of a double cell row panel of the present invention;

Figure 4A is a schematic sectional view showing the manner of folding a length of material to produce the panel of Figure 3;

Figures 4B and 4C are similar views illustrating two different ways in which the folded material is to be glued;

Figure 5 is a fragmentary, schematic vertical sectional view illustrating a first embodiment of a triple cell row panel constructed in accordance with the present invention;

Figure 6A is a schematic sectional view showing the manner of folding a length of material to produce the panel of Figure 5;

Figures 6B, 6C and 6D are similar views illustrating three different ways in which the folded material is to be glued;

Figure 7 is a fragmentary, schematic vertical sectional view illustrating a second embodiment of a triple cell row panel constructed in accordance with the present invention;

Figure 8A, 8B and 8C are schematic views illustrating three different manners in which the material is to be folded and glued in the construction of the panel illustrated in Figure 7;

Figures 9A and 9B are sectional views of a two layer and three layer material respectively suitable for use in making a multiple cell row panel of the invention;

Figure 10 is a side elevation of a folding and gluing portion of an apparatus for producing a multiple cell row panel of the invention;

Figure 11 is a side elevation of the winding and stacking portion of an apparatus for producing a multiple

cell row panel of the invention;

Figures 12A and 12B are a cross-sectional view and a top view of the strip opener of the apparatus of Figure 10;

5 Figures 13 and 14 are cross-sectional views of the first and the second glue applicators of the apparatus of Figure 10 respectively;

 Figures 15 and 16 are fragmentary schematic vertical sectional views illustrating the manner in which
10 the upper margins of the panels of Figure 5 and that of Figure 1, respectively, may be suspended from a header channel;

 Figure 17A is a vertical sectional view of a modified form of header channel to be used in suspending the
15 multiple cell row panels of the present invention;

 Figure 17B is a fragmentary top plan view of a support strip to be used in conjunction with the header channel of Figure 17A;

 Figure 18 is a fragmentary schematic sectional
20 view illustrating the manner in which a honeycomb shade or panel, including the multiple cell row panels of the invention, may be suspended from its upper margin using the structures illustrated in Figures 17A and 17B;

 Figure 19 is a fragmentary schematic vertical
25 sectional view illustrating the manner in which a multiple cell row panel may be supported using two retaining strips in conjunction with a header channel such as that illustrated in Figure 17A;

 Figures 20 and 21 are views similar to Figure 17A
30 showing second and third embodiments of a multiple cell panel support structure, respectively;

 Figure 22 is a fragmentary, schematic vertical sectional view illustrating a third embodiment of a triple cell row panel constructed in accordance with the present
35 invention;

Figure 23A is a schematic sectional view showing the manner of folding a length of material to produce the panel of Figure 22;

Figures 23B, 23C and 23D are similar views illustrating three ways in which the folded material is to be glued;

Figure 24 is a fragmentary, schematic vertical sectional view illustrating a first embodiment of a four cell row panel constructed in accordance with the present invention;

Figure 25A is a schematic sectional view showing the manner of folding a length of material to produce the panel of Figure 24;

Figures 25B and 25C are similar views illustrating two different ways in which the folded material is to be glued;

Figure 26 is a fragmentary, schematic vertical sectional view showing a second embodiment of a four cell row panel constructed in accordance with the present invention;

Figure 27A is a vertical sectional view showing the manner of folding a length of material to produce the panel of Figure 26;

Figures 27B and 27C are similar views illustrating two different ways in which the folded material is to be glued;

Figure 28 is a fragmentary, schematic vertical sectional view illustrating a first embodiment of a five cell row panel constructed in accordance with the present invention;

Figure 29A is a schematic sectional view showing the manner of folding a length of material to produce the panel of Figure 28;

Figures 29B, 29C and 29D are similar views showing three different ways in which the folded material is to be

glued;

Figure 30 is a schematic vertical sectional view illustrating a second embodiment of a five cell row panel constructed in accordance with the present invention;

5 Figure 31A is a schematic sectional view showing the manner of folding a length of material to produce the panel of Figure 30;

Figures 31B, 31C and 31D are similar views illustrating three different ways in which the folded
10 material is to be glued; and

Figures 32A, 32B and 32C are fragmentary, schematic vertical sectional views illustrating an alternative manner in which the upper margin of the panel of Figure 5 may be suspended from a header channel.

15 Referring now to Figure 1, the illustrated double cell row panel 10 is constructed of a plurality of longitudinally extending cells 3a-c, 4a-b arranged in two, offset rows 5, 6. For identification purposes only, rows 5 and 6 are referred to as the front row and back row
20 respectively, but use of these terms is not to be construed as in any limiting way.

Each cell has a longitudinally extending front face and a longitudinally extending back face, although only the front faces of the cells of the front row 5 and the back
25 faces of the cells of the back row 6 are ordinarily visible. More particularly, cell 3b has a visible front face 5b and cell 4b has a visible back face 6b.

Each complete cell of the front row 5 is formed from a single or separate piece of material 12. The back
30 face of an adjacent, offset cell of the back row 6 of double cell row panel 10 is formed from the same piece of material 12 as the adjacent complete cell of the front row 5. For example, the back face 6b of cell 4b is formed from the same piece of material 12 as the adjacent complete cell 3b. As
35 will be described more fully hereinafter, the novel system

of folding, gluing, and winding and/or stacking of the material strips 12 of the present invention provides the unique structure of the double cell row panel 10.

As can be seen from Figure 1, the front faces of the cells of the front row 5 and the back faces of the cells of the back row 6 are formed by opposite sides of the material pieces 12. Therefore, if the material 12 is identical in appearance on both sides thereof, panel 10 will have an identical appearance when viewed from the front and from the back. If the material 12 has a different appearance on each side, panel 10 will have a different appearance when viewed from the front and from the back.

To produce the double cell row panel 10, a strip material is creased, folded and provided with glue strips or zones using apparatus similar to that disclosed in US-A-4631217 and US-A-4631108, the disclosures of which are incorporated herein by reference. Further details will be described later.

The general manner of folding and providing a strip material with glue lines to produce the panel 10 is schematically illustrated in Figures 2A-2C. First, longitudinal crease lines 20, 22 are formed on opposite sides of a foldable, creasable strip material, between a central portion 24 of the material and longitudinal edges of the material. The strip is then folded longitudinally along the crease lines 20, 22 as shown, to provide what is referred to hereinafter as "Z-folding", as shown in Figure 2A. As there seen, the material 12 is initially of a width equal to six width units. The centre portion 24 of the folded material 12 provides three width units, the downwardly and inwardly folded flap 28 provides approximately one width unit and the upwardly and inwardly folded flap 26 provides approximately two width units.

Thereafter three longitudinal adhesive lines 18, 16, 14 are applied longitudinally on the folded material 12.

A first adhesive line 18 is applied to one surface 7 of the central portion 24 at a location approximately equal to one width unit from fold 22 suitable for securing the free edge of the flap 26 to the central portion 24 of the folded material 12, as shown in Figures 2B and 2C.

The adhesive strip 14 is located of the centre portion 24, substantially one width unit from fold 20, and the adhesive strip 16 is located adjacent the free edge of flap 28. In the embodiment of Figure 2B, two of the adhesive lines 16, 18 are located on one surface 7 of the material 12 and the third adhesive line 14 is located on the opposite surface 8.

An alternative placement of the three adhesive lines on the folded material 12a is shown in Figure 2C. In this embodiment, adhesive line 16a is located adjacent the free edge of flap 28a and the adhesive line 14a is located on the surface 8a at substantially the midpoint of flap 26a, about one width unit from fold 20a. Adhesive line 18a is as before. Again, the adhesive strips 16a, 18a are provided on one surface 7a of the material 12a and the adhesive strip 14a is provided on the other surface 8a of the material 12a.

The folded material with the three adhesive lines as shown in Figures 2B or 2C is wound or stacked such that successive portions of the material overlies preceding portions, as described in detail hereinafter, to form a plurality of adjacent stacked layers of folded material. During this stacking, the adhesive lines on the folded material are pressed into engagement with the facing side of an adjacent layer of folded material to connect them together and form adjacent connected layers to form a stack of double cell rows having the structure shown in Figure 1.

A second embodiment of a double cell row panel is shown in Figure 3, and is constructed of a plurality of longitudinally extending cells arranged in two, offset rows

Each complete cell of the back row 36 is formed from a single piece of material 42, that is, cell 34a is formed from one piece of material 42, cell 34b is formed from another piece of material 42, etc. The front face of the adjacent, offset cell of the front row 35 of double cell row panel 30 is formed from the same piece of material as the adjacent complete cell of the back row 36. For example, the front face 35b of cell 33b is formed from the same piece of material 42 as the adjacent complete cell 34a.

As can be seen from Figure 3, the front faces of the cells of the front row 35 and the back faces of the cells of the back row 36 are formed by the same surface of the material 42. Therefore, the double cell row panel 30 has an identical appearance when viewed from the front and from the back, provided that the material 42 has not been selected or printed to produce a different appearance from the front or back.

The method of producing the double cell row panel 30 of Figure 3 differs from the method of producing the double cell row panel 10 of Figure 1 primarily in the manner of folding the material. In contrast to the Z-folded condition of the material shown in Figure 2A, as shown in Figure 4A, to produce the panel 30 of Figure 3, both longitudinal edges of the material 42 are folded over the same side 37 of the material 42, to produce what is referred to hereinafter as "C-folding." Again, the folded material of Figure 4A comprises a centre portion 54 of approximately three width units between folds 50 and 52, a first inwardly folded flap 58 of approximately one width unit and a second inwardly folded longitudinal margin 56 of approximately two width units. After this folding three longitudinal adhesive lines 48, 46, 44 are applied. A first adhesive line 48 is applied to one surface 37 of the folded material 42, substantially two unit widths from the fold 50, in a location suitable for securing the free edge of the

longitudinal margin 56 to the central portion 54 of the folded material 42.

In the embodiment of Figure 4B, two of the adhesive lines 44, 46 are located on one surface 38 of the material 42 and the third adhesive or glue line 48 is located on the opposite surface 37. The adhesive strip 44 is located approximately one unit width from the fold 50 and the adhesive strip 26 is located adjacent the free edge of flap 58.

In the embodiment of Figure 4C, adhesive line 46a is located adjacent the free edge of flap 58a and the adhesive line 44a is located at substantially the midpoint of the margin 56a. Again, the adhesive strips 44a, 46a are provided on one surface 38a of the material 42a and the adhesive strip 48a is provided on the other surface 37a of the material 42a about two unit widths from fold 50a.

As before, the folded material with the three adhesive lines disposed thereon is subsequently wound and/or stacked to form a plurality of adjacent stacked layers of folded material.

Figure 5 shows a triple cell row panel 110, which comprises three rows of longitudinally extending cells, a front row 105, a back row 106 and an offset middle row 109 located therebetween. The cells in the front row 105 extend longitudinally, substantially parallel to corresponding cells in the back row 106, and these parallel cells may be considered as cell pairs 60a and 62a, 60b and 62b, 60c and 62c, and so on. The cells of the middle row 109 are formed by gluing two such cell pairs together. That is, gluing cell 60a to cell 60b along glue strip 113 and gluing cell 62a to cell 62b along glue strip 115 forms cell 64a of the middle row 109. Similarly, gluing cell 60b to cell 60c along glue line 113 and gluing cell 62b to cell 62c along glue line 115 forms cell 64b of the middle row 109.

Each cell pair, e.g., 60a, 62a is formed from a



single, folded material strip 112. Because of the way the material strip is folded, i.e., C-folded as described below, the same surface of the material 112 forms the front face of the front row cell of the cell pair and the back face of the back row cell of the cell pair. Therefore, the triple cell row panel 110 has an identical appearance from the front and the back, unless the material 112 has been selected or printed to produce a different appearance from the front and back.

10 The folding is such as to fold each longitudinal edge over the same side of the material along the respective crease lines. The folded condition of the length of material 112 used to produce the triple cell row panel 110 is shown in Figure 6A. As seen in Figure 6A, the material 15 112 is initially of a width equal to eight width units. The centre portion 124 of the folded material 112 comprises approximately four width units, and the upwardly and inwardly folded flaps 126, 128 each comprise approximately two width units.

20 Figures 6B-6D show several embodiments of the positioning of the four adhesive lines on the folded material 112; in Figures 6B-6D, two parallel adhesive strips or zones are applied to one surface 107 of the folded material 112 in locations suitable for securing the free 25 edges of the longitudinal margins 126, 128 to the central portion 124 of the folded material 112. In Figures 6B and 6C, these first adhesive strips or zones 116, 117 and 116a, 117a are located substantially equidistant from their respective folds 120, 122 and 120a, 122a. Two additional 30 adhesive strips or zones 113, 115 are located on the opposite surface 108 of the material 112 from the adhesive strips 116, 117 in the embodiment of Figure 6B, at substantially the midpoints of the flaps 126 and 128 respectively. In the embodiment of Figure 6C, adhesive 35 strips 113a, 115a are located on the opposite surface 108a

of the central portion 124a from the adhesive strips 116a, 117a at approximately one unit width from the folds 120a and 122a respectively.

In the embodiment of Figure 6D, adhesive strips 116b, 117b are applied to the surface 107b of the material 112b, adjacent the free edges of the flaps 126b, 128b. Adhesive strip 113b is applied to the surface 108b of the central portion 124b of the material 112b, approximately one width unit from the fold 120b. Adhesive strip 115b is applied to the surface 108b of the material 112b at approximately the midpoint of the flap 128b. Again, in this embodiment the adhesive strips 113b, 115b are applied to one surface 108b of the material 112b and the adhesive strips 116b, 117b are applied to the other surface 107b of the material 112b.

The triple cell row panel 130 shown in Figure 7 is an "offset" honeycomb panel, meaning that the cells of the middle row 139 are of a different size, in this case smaller, and have a different configuration from those of the front row 135 and the back row 136. Here, the distance x from the glue line 143 to the midpoint M of the folded material 142 is less than the distance y from the glue line 143 to the fold 150. Similarly, the distance x' from the glue line 145 to the midpoint M of the folded material 142 is less than the distance y' the glue line 145 to the fold 152. As the distances x and x' decrease by moving the glue lines 143 and 145, respectively, closer to the midpoint M of the folded material 142, the sizes of the cells of the front row 135 and the back row 136 increase and the size of the cells of the middle row 139 decrease.

As shown in Figure 8A, glue lines 143, 145 are farther from their respective folds 150, 152 than corresponding glue lines 113, 115 in Figure 6B. Similarly, in the embodiment of Figure 8B, glue lines 143a, 145a are closer to midpoint M of the folded material 142a than

corresponding glue lines 113a, 115a of Figure 6C. Glue lines 143b, 145b of Figure 8C are similarly displaced relative to respective glue lines 113b, 115b of Figure 6D.

A third embodiment of a triple cell row panel 610 of the present invention is shown in Figure 22 and again comprises three rows of longitudinally extending cells, a front row 605, a back row 606 and an offset middle row 609 located therebetween. The cells in the front row 605 extend longitudinally, substantially parallel to corresponding cells in the back row 606, and these parallel cells may be considered as a cell pair; thus cells 660a and 662a; 660b and 662b; and 660c and 662c each form a cell pair, and so on. The cells of the middle row 609 are formed by gluing two such cell pairs together as shown in Figure 22. That is, gluing cell 660a to cell 660b along glue strip 613 and gluing cell 662a to cell 662b along glue strip 615 forms cell 664a of the middle row 609. Similarly, gluing cell 660b to cell 660c along glue line 613 and gluing cell 662b to cell 662c along glue line 615 forms cell 664b of the middle row 609. Each cell pair is formed from a single, folded material strip 612. Because of the way the material strip is folded, i.e., Z-folded as described below, the front faces of the cells of the front row 605 and the back faces of the cells of the back row 606 are formed by opposite sides or surfaces of the material strip 612. Therefore, if the material 612 is identical in appearance on both sides thereof, panel 610 will have an identical appearance when viewed from the front and from the back. If the material 612 has a different appearance on each side or surface, panel 610 will have a different appearance when viewed from the front and from the back.

The method of producing the triple cell row panel 610 of Figure 22 differs from the method of producing the triple cell row panel 110 of Figure 5 primarily in the manner of folding the material. In contrast to the C-folded

condition of the material shown in Figure 6A as shown in Figure 23A, the material is Z-folded, one longitudinal edge of the material 612 being folded over one surface 637 of the material 612 along one crease line and the other
5 longitudinal edge being folded over the opposite surface 638 of the material along the other crease line. The material 612 is initially of a width equal to eight width units, the centre portion 624 of the folded material 612 forming approximately four width units, the upwardly and inwardly
10 folded flap 626 forming approximately two width units and the downwardly and inwardly folded flap 628 forming approximately two width units.

Figures 23B-23D show several embodiments of the positioning of the four adhesive lines on the folded
15 material 612 to produce the triple cell row panel 610 shown in Figure 22. In Figure 23B, the first adhesive lines 616, 617 are located on opposite surfaces 637, 638, respectively, of the central web portion 624, substantially equidistant from their respective folds 620, 622. Two additional
20 adhesive lines 613, 615 are provided on opposite surfaces 628, 627, respectively, of the material 612, with adhesive line 613 located at substantially the midpoint of the flap 626 and the adhesive line 615 located on the central web portion 624, approximately one width unit from the fold 622.

25 In Figure 23D adhesive line 616b is applied to surface 637b of the folded material 612b, adjacent the free edge of the flap 626b. Adhesive strip 617b is applied to the surface 638b, adjacent the free edge of the flap 628b. Adhesive strip 613b is applied to the surface 638b of the
30 flap 626b, approximately one width unit from the fold 620b. Adhesive strip 615b is applied to the surface 637b of the material 612b at approximately the midpoint of the flap 628b.

In each of these embodiments two of the adhesive
35 lines are applied to one surface 628 and the other two are

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applied to the other surface 637 of the material 612.

Referring now to Figure 24, there is shown a four cell row panel 710 which comprises four rows of longitudinally extending cells, a front row 705, a back row 706 and two offset middle rows 709a, 709b, located between the front and back rows.

The C-folded condition of the material strip 712 is shown in Figure 25A. As there seen, the material strip 712 is initially of a width equal to ten width-units. The centre portion 724 of the folded material 712 forms approximately five width units, the downwardly and inwardly folded longitudinal flaps 726 and 728 form approximately three width units and two width units respectively.

After the material 712 has been folded as shown in Figure 25A, five adhesive lines are applied longitudinally on the folded material 712. Adhesive line 716 is applied on one surface of the material 712, approximately two width units from fold 722, adhesive line 714 is applied to the same surface of the material 712 approximately two width units from fold 720 and one width unit from adhesive line 716. A portion of longitudinal flap 726 about two width units from the fold 720 is secured to the central portion 724 by the adhesive line 714. Adhesive lines 713, 715 and 717 are applied to the opposite surface of the material 712. Adhesive line 713 is located about one width unit from the fold 720; adhesive line 715 is located adjacent the free end of longitudinal flap 726; and adhesive line 717 is located about one width unit from fold 722.

An alternative placement of the five adhesive lines is shown in Figure 25C, in which adhesive line 713a is located on the central portion 724a, on the opposite surface from adhesive lines 714a and 716a, about one width unit from the fold 720a. Adhesive line 717a is also located on the central portion 724a, on the same surface of material 712a as adhesive line 713a, about one width unit from fold 722a.

A second embodiment of a four cell row panel 750 is shown in Figure 26, and is produced from Z-folded material 752 (see Figure 27A), which again comprises ten width units including a central portion 774 of approximately five width units. The folded material 752 further comprises a downwardly and inwardly folded longitudinal flap 776 of approximately three width units and an upwardly and inwardly folded longitudinal flap 778 of approximately two width units.

Five adhesive lines are applied longitudinally on the folded material 752. Adhesive line 766 is applied on one surface of the material 752, approximately two width units from fold 772; adhesive line 764 is applied to the opposite surface of the material 752 approximately two width units from fold 770 and one width unit from adhesive line 766. A portion of longitudinal flap 776 about two width units from the fold 770 is secured to the central portion 774 by the adhesive line 764. Adhesive lines 763 and 765 are applied to the same surface of the material 762 as adhesive line 766. Adhesive line 763 is located on longitudinal flap 776, about one width unit from the fold 770 while line 765 is located adjacent the free end of flap 776. Adhesive line 767 is located about one width unit from fold 772, on the central portion 774 and on the same surface as adhesive line 764.

An alternative placement of the five adhesive lines is shown in Figure 27C, in which adhesive line 763a is located on the central portion 774a, on the opposite surface from adhesive line 764a, about one width unit from the fold 770a. Adhesive line 767a is located on the longitudinal flap 778, on the same surface as adhesive line 764a, about one width unit from fold 772a.

Referring now to Figure 28, there is shown a five cell row panel 810 which comprises five rows of longitudinally extending cells, a front row 805, a back row

806 and three middle rows 809a, 809b, 809c. The cells of the front row 805 extend longitudinally, substantially parallel to the cells of the middle row 809b and the back row 806. The cells of the middle rows 809a and 809c are formed by gluing together a cell "triplet" including parallel front row 805, middle row 809b and back row 806 cells to another cell triplet along glue or adhesive lines 831, 816 and 818. The five cell row panel 810 is produced from a C-folded material strip 812.

The C-folded condition of the material strip 812 is shown in Figure 29A. As there seen, the material strip 812 is initially of a width equal to twelve width units. The centre portion 824 of the folded material 812 comprises approximately six width units, the upwardly and inwardly folded longitudinal flaps 826 and 828 form approximately two width units, and four width units, respectively.

Seven adhesive lines are applied longitudinally on the folded material 812. As shown in Figure 29B, adhesive line 814 is applied on one surface of the material 812, approximately two width units from fold 820; adhesive line 815 is applied to the same surface approximately four width units from fold 820 and adjacent adhesive line 814. A portion of longitudinal flap 828 about two width units from the fold 822 is secured to the central portion 824 by the adhesive line 817. Adhesive lines 813, 816 and 818 are applied to the opposite surface of the material 812, line 813 being located about one width unit from the fold 820, line 816 being located at approximately the midpoint of central portion 824 and line 818 being located about one width unit from fold 822.

An alternative placement of the seven adhesive lines is shown in Figure 29C, in which adhesive line 813a is located on the longitudinal margin 826a on the opposite surface from adhesive lines 814a and 815a, about one width unit from the fold 820a. Adhesive lines 816a and 818a are

located on the longitudinal flap 828a, three and one width units, respectively, from the fold 822, on the same surface of material 812a as adhesive line 813a.

Another placement of the seven adhesive lines is shown in Figure 29D, in which adhesive lines 814b and 815b are located adjacent the free ends of longitudinal flaps 826b and 828b, respectively.

A second embodiment of a five cell row panel 850 is shown in Figure 30, with the panel produced from Z-folded material 852 (Figure 31A) which comprises twelve width units including a central portion 874 of approximately six width units. The folded material 852 further comprises a downwardly and inwardly folded longitudinal flap 876 of approximately two width units and an upwardly and inwardly folded longitudinal flap 878 of approximately four width units.

Seven adhesive lines are applied longitudinally on the folded material 852. As seen in Figure 31B, adhesive line 854 is applied on one surface of the central portion 874 of the material 852, approximately two width units from fold 870, to secure the free edge of longitudinal margin 876 to the central portion 874. Adhesive line 855 is applied to the opposite surface approximately four width units from fold 872 and adjacent adhesive line 854, to secure the free end of longitudinal margin 878. A portion of longitudinal flap 878 about two width units from the fold 872 is secured to the central portion 874 by the adhesive line 857. Adhesive lines 856 and 858 are applied to the same surface of the material 852 as adhesive line 854. Adhesive line 856 is located on central portion 874, about three width units from the fold 872. Adhesive line 858 is located about one width unit from fold 872. Adhesive line 853 is located on longitudinal margin 876, on the same surface of the material 852 as adhesive lines 855 and 857, about one width unit from fold 870.

An alternative placement of the seven adhesive lines is shown in Figure 31C, in which adhesive line 853a is located on the central portion 874a, about one width unit from fold 870a. Adhesive lines 856a and 858a are located on longitudinal flap 878a, approximately three and one width units from fold 872a, respectively.

In the embodiment of Figure 31D, adhesive line 854b is located on the longitudinal flap 876b, adjacent the free end and line 855b is located on the other longitudinal flap 878b, adjacent the free end thereof.

In addition to the double, triple, four and five cell row panels described in detail above, multiple cell row panels having six or more cell rows are also contemplated within the scope of the present invention. Multiple cell row panels having an even number of cell rows, e.g., six, eight, etc., can be constructed by folding a strip material in either a Z-fold configuration or a C-fold configuration and applying an appropriate number of adhesive lines, similar to the manner of folding and gluing to produce the four cell row panels described above. Multiple cell row panels having an odd number of cell rows, e.g., seven, nine, etc., can be constructed by folding a strip material in either a Z-fold configuration or a C-fold configuration and applying an appropriate number of adhesive lines, similar to the manner of folding and gluing to produce the five cell row panels described above.

As is apparent from the foregoing description of illustrative multiple cell row panels of the present invention, to produce a multiple cell row panel having N number of cell rows (N being greater than 1), a strip material is Z-folded or C-folded to provide a folded material of $2N + 2$ width units; and then $N + 2$ adhesive lines are applied to the folded material. In multiple cell row panels having an even number of cell rows, one of the adhesive or glue lines is located so as to secure a free end

of one longitudinal flap to the central portion of the folded material. In a multiple cell row panel having an odd number of cell rows, one adhesive line is located on the folded material so as to secure the free end of one longitudinal flap to the central portion and another
5 adhesive line is located on the folded material so as to secure the free end of the other longitudinal flap to the central portion of the folded material. Finally, although the "offset" embodiment has been described and illustrated
10 by reference to a triple cell row panel of the present invention, offset multiple cell row panels of two, four, five and more cell rows are also contemplated within the scope of the present invention.

To fabricate the multiple cell row panels shown in
15 Figures 1, 3, 5, 7, 22, 24, 26, 28 and 30, a method based on the method disclosed in US-A-4631108 and 4631217 may be used, but modified in accordance with the present invention, as shown in Figures 10 and 11. This is adapted to produce the triple cell row panel 110 of Figure 5 from a material
20 folded and glued as shown in Figure 6C. Modifications to this apparatus to produce the other embodiments of the invention described above will be discussed hereinafter.

As shown in Figure 10, a continuous strip of foldable, creasable and drapable material 410 is provided
25 from a supply roll 412. The material may be a thin film of polyester, or possibly a non-plastic material, such as a non-woven or woven fabric, or a laminated material having suitable characteristics, including the ability to be readily folded and creased and to drape in an aesthetically
30 pleasing manner from a fold or crease zone thereof. The fabric should also have the ability to have various sections thereof glued or otherwise bonded together and, preferably, also have the ability to be supported along a top margin of a vertical multiple cell row panel constructed of such
35 material. An especially suitable and preferred material is

a polyester, spun-bonded non-woven fabric.

The fabric may also be selected based on the particular purpose for which the panel is to be used. For example, to produce a blackout multiple cell honeycomb panel, the fabric can be a two layer or two ply laminate having a non-woven polyester material 180 on one side and a thin polyester film material 182, such as Mylar, on the other side as shown in Figure 9A. This has the additional advantage of increasing the insulating effect of the multiple cell row panel approximately 40% and 50% over that achieved by a similar panel produced from a single layer material. The material can also be a three layer laminate having a layer of polyester film 190, e.g. Mylar, sandwiched between two layers 192, 194 of non-woven polyester material as shown in Figure 9B. Two- and three-ply laminates of this type are generally known in the art and have been used in other types of window coverings.

Generally, the material for a multiple cell row panel for the present invention should be softer than the material for a single cell honeycomb panel; however, materials previously used to fabricate single cell honeycomb panels may also be used in the multiple cell row panels of the present invention.

From the supply roll 412, the strip material 410 is directed around a series of guide rollers 414, 416 and 418 and over a pair of alignment rollers 420, 422, mounted on respective shafts and driven in the directions indicated by the arrows in Figure 10. The alignment rollers have radially extending raised edges spaced by a distance slightly greater than the width of the strip material 410.

The strip material 410 then passes around a rubber surfaced backing roller 432 of a creaser assembly 430, having a pair of creaser wheels 434, with sharp peripheral edges, which press a pair of longitudinally extending permanent creases in spaced apart relation to each other on



the same side of the strip material 410. The creases define lines of demarcation between the opposite longitudinal flaps of the strip material 410 and the central portion thereof. Suitable creaser wheels for folding the strip material 410 in the manner in Figure 6A are shown, for example in Figure 2 of US-A-4631108.

The strip material 410 is then fed through a folding assembly 440 which folds the strip material longitudinally along the crease lines to form folds 120, 122 shown in Figure 6A, for example. The folding is such as to fold each longitudinally flap over the central portion on the same side of the strip material 410. The folding assembly 440 includes a folding roller 442 which causes the longitudinal flap to fold upwardly to nearly a right angle relative to the central portion of the strip material. The folding roller 442 curves the strip material 410 with the edges folded upwardly so that the distance travelled by the central portion of the strip material 410 equals the distance travelled by the folded up longitudinal flaps. The strip material 410 then enters a folding box 444, which includes a passage having a height less than the width of the longitudinal flaps of the strip material to cause the longitudinal flaps to fold over on top of the central portion to form the structure shown in Figure 6A. The folding box 444 may be of any construction suitable for folding the material along the longitudinal creases, such as a folding channel or a series of rotatable rollers spaced at an appropriate distance from a planar wall of the folding box.

As the folded strip material 410 leaves the folding box 444, it passes through a crimper assembly 450, which includes a large roller 452 rotatable about shaft 454. A spring biased crimp roller 456 is positioned adjacent the peripheral surface of the roller 452 such that as the folded strip material 410 passes between the crimp roller 456 and

the peripheral surface of roller 452, it is tightly pressed and squeezed to form folds in the strip material 410 along the creases formed by the creaser assembly 430. The folded strip material 410 then passes over guide rollers 460, 462 and into heat roller assembly 470, which comprises a pair of heated rollers 472, 474 over the periphery of which the material 410 passes in turn, to heat it to a temperature sufficient to achieve sharp, permanent folds. Assembly 470 permanently sets the folds and provides the unique and aesthetically pleasing outwardly pointed folds 350, 352 of the panel 110 shown in Figure 5. Each of these heated roller 472, 474 is heated to a temperature of about 120° to 200°C. As the strip material 410 is heated against the peripheral surfaces of the rollers 472, 474 under the slight tension in the operating system, the molecular structure of the strip material 410 rearranged to set the longitudinal creases permanently.

While the strip material 410 is still hot, it passes between the press rollers 476, 478 which apply a rolling pressure across the entire width of the strip material to set the longitudinal creases permanently.

After the strip material 410 then travels around the peripheral surface of the drive roller 480, which is cooled to below 90°C, further to ensure that the creases are set permanently. The drive roller 480 is journaled on a shaft 482, and is rotated by a motor and drive belt (not shown), press roller 478 additionally applying the strip material 410 against the cylindrical peripheral surface of the drive roller 480 to provide the traction necessary for pulling film 410 through the apparatus.

In the heat roller assembly 470, the material 410 is heated to a very high temperature, between about 120° and 200°C depending on the material used, to melt the crystalline structure of a polyester material and cause it to become suitably deformable or stretchable. This allows a

permanent crease to be put in the material 410, but it also could permit the material 410 to stretch excessively. In many cases, when brought to these temperatures, polyester material will shrink slightly in the machine direction. If
5 the material is kept at a low enough tension, this shrinkage is desirable as further shrinkage will not occur when a shade is put in a window and exposed to the high temperature of the sun. Therefore, it is desirable to keep the tension through the heat roller assembly 470 both on the heating
10 side, i.e., before heat roller 472, and on the cooling side, i.e., after cooled drive roller 480, as low as is practicable.

To achieve the minimum tension level at which the machine will operate, dancer assemblies which exert a
15 biasing force against the material are provided before and after the heat roller assembly 470; the dancer assembly before the heat roller assembly 470 includes guide roller 460 mounted on one end of vertical arm 461, which is pivotally mounted such that the guide roller 460 can swing
20 from about 45° to 60° in order to adjust slack between the crimper assembly 450 and the heat roller assembly 470. The dancer assembly after the heat roller assembly 470 includes guide roller 484 which is mounted on one end of horizontal arm 485, which is also pivotally mounted, to permit guide
25 roller 484 to swing and thereby adjust slack in the material 410 between heat roller assembly 470 and the glue applicators.

There are separate motors (not shown) controlling the folding section, the heat roller section and the
30 adhesive application section of the machine. The motor speeds are then proportioned by the dancers automatically so that the dancers will remain roughly at the midpoint. In practice, the heat roller drive follows the speed of the adhesive applicator drive and is slightly proportioned
35 faster or slower as the dancer 484, 485 between the two of

these motors changes position. For example, if the dancer 484, 485 moves up, giving a longer loop of fabric, the heat roller drive is slightly slowed by this movement. On the other hand, if the dancer 484, 485 moves downward, the heat roller 484, 485 drive is slightly sped-up to compensate and keep the dancer at midpoint. The dancer 460, 461 between the folder drive and the heat roller drive works similarly with the folder drive and the heat roller drive works similarly with the folder drive speed following the heat roller drive speed proportioned slightly by the position of the dancer 460, 461 between the two of them.

From the drive roller 480, the folded strip material 410 passes between guide rollers 484 and 486 and around aligning rollers 488, 489 so that the folded strip material 410 is properly aligned for the adhesive applicator assembly. Aligning rollers 488 and 489 are of similar construction to aligning rollers 420 and 422.

Thereafter the strip material 410 passes over strip opener 490 to open the folded strip material 410 sufficiently to deposit glue on the inner surface thereof as shown in Figures 12A and 12B. As the strip material 410 passes over the strip opener 490, the folded longitudinal flaps are displaced downwardly and outwardly to provide access to the central portion of the strip material 410.

Two centre lines of adhesive are then applied to the inner surface of the central portion of the strip material 410 by the glue applicator 492 (Figure 13), which has two spaced apart nozzles 494, 496 through which glue 498 is applied in two uniform parallel glue lines 500, 502 on the inner surface of the central part of the folded strip material 410. As described in US-A-4631108, the glue applicator assembly includes a positive displacement gear pump (not shown) which is effective to apply glue in direct proportion to the rotational speed of the pump, which pump rotates at a speed directly proportional to the speed of

rotation of the drive roller 480, so that the amount of glue applied is proportional to the linear speed of the strip material 410.

A glue press assembly 504 includes a roller biased
5 against the upper surface of the strip material 410 beyond the glue applicator 492 and a bottom aligned shaft is provided to support the strip material 410 before the glue applicator 492, to ensure that the material 410 is consistently and properly located with respect to the glue
10 nozzles 494, 496 to ensure uniformity of the glue lines 500, 502.

The glue press permits adjustment of the spacing between the glue nozzles and the material 410 passing thereover. Preferably, this spacing is adjusted to provide
15 a flattened glue line, rather than a rounded bead, so as to provide greater control of the amount of glue applied and prevent the glue from undesirably spreading out when the fabric is pressed against another piece of fabric.

The choice of adhesive depends upon the type of
20 material 410. Preferably, the glue is a hot melt adhesive which has no strength at room temperature and must be exposed to high humidity to harden. An especially preferred adhesive for use with the preferred non-woven, spun-bonded polyester material is a 100% solids, urethane, cross-linking
25 hot melt adhesive. If a two layer laminate having a layer of polyester film which must be secured to itself by a glue line is used as the material 410, a suitable adhesive would be a silicone based 100% solids adhesive. Of course, other adhesives such as a hot melt adhesive which cures rapidly at
30 room temperature could also be used.

After the glue applicator 492, the strip material 410 is permitted to return to its closed, folded position such that the edges of the longitudinal flaps contact the respective glue lines 500, 502. The closed, folded strip
35 material 410 passes around aligning rollers 520, 522 and

then through second glue assembly 524, which, as shown in Figure 14, is similar in construction to glue assembly 492, except that the glue nozzles 526, 528 are spaced further apart. Glue applicator 524 also discharges two uniform
5 beads of glue onto the folded strip material 410 and the amount of glue discharged thereby is proportional to the linear speed of the strip material 410 passing through the apparatus. Glue applicator 524 applies more glue in lines 530, 532 than applicator 492 applies in lines 500, 502
10 because the glue lines 530, 532 require greater bonding strength, since the forces applied to glue lines 530, 532 are greater in the final multiple cell row panel. The relative amounts of glue applied by the glue applicator 524 as glue lines 530, 532 and by the glue applicator 492 as
15 glue lines 500, 502 is determined by a gearing mechanism (not shown).

Adjacent second glue applicator 524 there is provided a second glue press 534 which is identical to that of the glue press associated with the first glue applicator
20 492.

The folded strip material passes around aligning roller 536 and then is pressed between press roller 538 and split roller 540, which has a recessed portion therein to allow the glue lines 530, 532 to pass thereover undisturbed.
25 Thereafter, it proceeds to a tension and speed control assembly 550 which comprises a dancer roller 552 rotatably mounted on a carrier 554, which is slidably mounted on rail 556. Thus a constant tension may be maintained on the strip material 410 as it passes through the apparatus and is wound
30 around the stacking arm shown in Figure 11, which has the same structure shown in US-A-4631108. As the stacking arm rotates in the angular direction, it takes up and winds the strip material 410 around itself in successive lengths approximately equal to the length of the stacking bed. As
35 the stacking arm rotates in the direction indicated by the

arrow, two stacks of the strip material 410 are deposited in layers on opposite flat surfaces of the stacking bed. As an end of the stacking arm approaches the aligning roller, the velocity of the strip material 410 drawn around the rollers decreases significantly. The tension and speed control assembly 550 compensates for this difference in speed between the strip material 410 being pulled through the apparatus by the drive roller 480 and the strip material 410 being pulled by the stacking arm. The slack thus created is taken up by the tension and speed control assembly 550 by movement of the dancer roller 552 and its carrier 554 along rail 556.

After a desired number of layers of material 410 have been wound around stacking arm 600, the stacking bed 602 is removed from its support 604 and placed in a curing chamber to cure the adhesive and complete production of the triple cell row panel. The curing chamber is maintained at a temperature and humidity appropriate for the particular adhesive used and, similarly, the curing time is adapted for the particular adhesive. For example, when the adhesive is the preferred 100% solids, urethane, cross-linking hot melt adhesive, the curing chamber is maintained at 38°C and 95% humidity and the adhesive is allowed to cure for about 4 hours. After the curing is complete, the rounded end sections of the stacked layers are cut away from the stack, and two panels having the structure shown in Figure 5 are produced. If the adhesive does not require curing, the rounded end sections can be cut off the stack immediately after winding to produce the triple cell row panels.

In order to produce other embodiments of the multiple cell row panels described herein, modifications to the method and/or apparatus detailed above are necessary. Thus, to produce a triple cell row panel from a folded material having the glue lines applied as in Figure 6B, the first and second glue applicator assemblies would be

disposed on opposite sides of the strip material 410 as it passes through the apparatus. To produce the triple cell row panel from a folded material having the glue lines applied as in Figure 6D, the second glue applicator assembly
5 is replaced by two glue applicator assemblies having a single nozzle, the two single nozzle glue applicator assemblies being disposed on opposite sides of the strip material 410. The offset triple cell row panel shown in Figure 7 can be produced by the same methods, using the same
10 apparatus and modifications discussed above, as the triple cell row panel of Figure 5. The only difference would be in the spacing of the glue lines applied to the outer surface of the folded material. To produce the triple cell row panel shown in Figure 22, the creaser assembly is replaced
15 by a creaser assembly having two separate creaser wheels disposed on opposite sides of the material 410, as described in US-A-4631217 to produce the folded configuration of Figure 23A.

To produce the double cell row panel shown in
20 Figure 1, the creaser assembly of US-A-4631217 is used to produce the folded configuration shown in Figure 2A. The first glue applicator is replaced by a single nozzle glue applicator to apply the single centre line of glue, and then, depending upon the location of the additional two glue
25 lines, appropriately located single nozzle glue applicators, or a double nozzle glue applicator are provided. Finally, to produce the double cell row panel of Figure 3, the creaser assembly described above with reference to Figures 5 and 6A, and illustrated in US-A-4631108, is modified, to
30 change the spacing of the creaser wheels as necessary to produce the unsymmetrical folded material shown in Figure 4A. Appropriate single and double nozzle glue applicators are provided to produce the structures shown in Figures 4B and 4C.

35 The four and five cell row panels of Figures 24

and 26 and Figures 28 and 30, respectively, are similarly produced, using apparatus having appropriately positioned single and double nozzle glue applicators to produce the desired glue line placement as shown in Figures 25B-C, 27B-C, 29B-D and 31B-D. The creaser assembly of US-A-4631108, with the creaser wheel spacing modified as necessary, is used to produce the C-folded structures of Figures 25A and 29A. The creaser assembly of US-A-4631217, with the creaser wheel spacing modified as necessary, is used to produce the Z-folded structures of Figures 27A and 31A.

The present invention further relates to methods and apparatus for mounting a honeycomb panel, especially a multiple cell honeycomb panel, in a vertical position. As shown in Figure 15, a standard stiffener strip 230 may be inserted into the upper margin of the panel 110, upon the latter being cut along cut lines or zones 232 and 234, see Figure 5, and utilized to support the upper margin of the panel 110 from a downwardly opening C-shaped header channel 236 open at at least one end and preferably at both ends. Alternatively, the upper margin of the panel 110 can be cut along line 238 as well as lines 232 and 234, using a three-bladed cutting tool. Then, the portions of the panel 110 adjacent cut line 238 are wrapped around the stiffener strip and secured thereto by transfer tape, prior to mounting in the header channel.

Figure 16 illustrates the manner in which the panel 10 illustrated in Figure 1 may likewise be supported from a horizontal C-shaped header channel 236 using a stiffener strip 230 by cutting the upper margin of the panel 10 along cut line or zone 240, see Figure 1. After the panel 10 is cut along zone 240, an appropriate stiffener strip 230 is inserted into the upper margin of the panel 10 and then the upper margin of the panel 10 and the appropriate stiffener strip 230 are lengthwise inserted into the header channel 236 from one open end thereof, the panel

110 being inserted into the header channel 236 operatively associated therewith in Figure 15 in a similar manner.

Figures 32A-C illustrate a further method for inserting a standard stiffener strip 230 into the upper margin of the panel 110. As shown in Figure 32A, the uppermost cells 60a, 62a are cut along lines 902, 904. Stiffener strip 230 is then inserted between the cut portions as shown in Figure 32B. The cut edges of cells 60a, 62a, are then closed over stiffener strip 230 and secured with tape 906, as shown in Figure 32C. The cut edges of cells 60a, 62a could also be secured individually and directly to stiffener strip 230 by transfer tape or the like.

Figure 17A illustrates an upwardly opening header channel or support strip 250 and including two rows of spaced downward projections 252 with resilient barbed heads supported therefrom. Figure 17B illustrates a stiffener strip 254 corresponding to the stiffener strips 230 illustrated in Figures 15, 16 and 32B and C, but which includes two rows of holes or openings 256 formed therein registerable with the projections 252 when the strip 254 is disposed immediately beneath the header channel or support strip 250.

When the components of Figures 17A and Figure 17B are used in combination, they even may be used to support the upper margin 258 of a known honeycomb shade or panel, as disclosed in US-A-4603072 and 4631108, referred to in general by the reference numeral 260, when the upper cell 262 of the panel 260 is provided with openings corresponding to the openings 256, see Figure 18.

Figure 19 illustrates the channel or support strip 250 of Figure 18 having the spaced barbed downward projections 252 utilized in conjunction with a pair of stiffening strips 254 each provided with a single row of openings 256, the stiffening panels 254 being insertable in

the upper portions of the two outside uppermost cells 270 of the panel 110, or the upper portions of the two outside cells 272 of the double row cell panel 10 illustrated in Figure 1.

5 With reference to Figure 20, an upwardly opening header channel or support strip 280 is illustrated including two rows of longitudinally spaced openings 282 formed therein. A single stiffening strip 284 is provided upwardly from which project headed projections 286 with resilient
10 barbed heads corresponding to the projections 252. The projections 286 are registerable with the openings 282 and receivable through corresponding openings (not shown) in the upper cells of any one of the multiple cell row panels of the present invention or a honeycomb shade or panel such as
15 that illustrated at 260 in Figure 18.

 Finally, referring now to Figure 21, an upwardly opening header channel or support strip 310 is shown including one row of longitudinally spaced openings 312 and one row of downwardly projecting headed projections 314 with
20 resilient barbed heads. A single stiffening strip 316 is provided having one row of longitudinal spaced openings 318 and one row of upwardly projecting headed projections 320 with resilient barbed heads. As shown, the projections 314 of the header channel are registerable with and receivable
25 through the openings 318 of the stiffening strip 316 and the projections 320 of the stiffening strip 316 are registerable with and receivable through the openings 312 of the header channel 310. The header channel 310 could also be used with two separate stiffening strips, one being provided with
30 longitudinally spaced openings for receiving the projections 314 and the other being provided with upwardly projecting headed projections with resilient barbed heads receivable through the openings 312 of the header channel 310.

CLAIMS

1. An expandable and contractible honeycomb panel including a plurality of parallel laterally adjacent
5 longitudinally extending rows of elongate tubular cells, the cells extending transversely of said rows in common directions normal to the relative lateral positioning of said rows, with the tubular cells of each row being offset longitudinally relative to the tubular cells of each
10 adjacent row of tubular cells, said cells being constructed of a foldable, creasable and drapable material in the form of superposed material strips, each including a centre web extending longitudinally of the material strip and opposite side longitudinal marginal flaps folded inwardly into lapped
15 relation with corresponding side portions of said centre web, the free edge of at least one of said flaps being bonded to an associated opposing portion of said centre web and each said material strip including at least two laterally spaced and longitudinally extending bond lines
20 along which said material strip is bonded to opposing narrow zones of at least one adjacent strip, said material strips each forming one cell in one of said rows of cells and at least approximately three-quarters of at least one cell in another row of cells.

25

2. A panel according to claim 1, wherein the free edge of the other of said flaps is bonded to the opposing longitudinal zone of said centre web.

30 3. A panel according to claim 2, wherein said two laterally spaced bond lines extend along the sides of said folded flaps remote from said centre web.

4. A panel according to claim 2, wherein said two
35 laterally spaced bond lines extend along the face side of

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said centre web remote from said folded flaps.

5. A panel according to any preceding claim, wherein the foldable, creasable and drapable material is a polyester, spun-bonded, non-woven fabric.

6. A panel according to any one of Claims 1 to 4, wherein the foldable, creasable and drapable material is a laminate comprising at least one layer of a non-woven polyester fabric and at last one layer of a polyester film material.

7. A panel according to any preceding claim, wherein each of the folds in said material strip between said centre web and said inwardly folded flaps is permanently creased.

8. A panel according to any preceding claim, wherein said panel includes two rows of cells, only, and the cells in the two rows of cells are staggered longitudinally of said rows relative to each other and wherein each of said folded strips comprises six width units, the centre web being about three width units, a first of said longitudinal flaps being about one width unit and a second of said longitudinal flaps being about two width units, said first and second longitudinal flaps being folded inwardly over the same surface or opposite surfaces of the centre web.

9. A panel according to any one of Claims 1 to 7, wherein said panel includes three rows of cells consisting of two outside rows of cells and a centre row of cells therebetween, corresponding cells of said outside rows of cells being laterally registered and the cells of said centre row of cells being staggered longitudinally of said rows relative to the cells of said outside rows of cells,





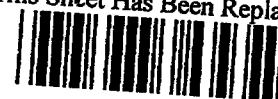
said material strips each forming a pair of complete cells with the pair of cells formed by each material strip comprising corresponding laterally registered cells of said outside rows of cells and a centre row cell is formed
5 between the pairs of laterally registered cells of adjacent material strips.

10. A panel according to claim 9, wherein each of said folded strips comprises eight width units, the centre web
10 being about four width units, the longitudinal flaps each being about two width units, said first and second longitudinal flaps being folded inwardly over the same surface or opposite surfaces of the centre web.

15 11. A panel according to any one of claims 1 to 7, wherein said panel includes four rows of cells, corresponding cells of the first and third rows being laterally registered and corresponding cells the second and fourth rows being laterally registered, and the cells of the
20 first and third rows being staggered longitudinally of said rows relative to the cells of the second and fourth rows, each of said folded strips comprises ten width units, the centre web being about five width units, a first of said longitudinal flaps being about two width units and a second
25 of said longitudinal flaps being about three width units, said first and second longitudinal flaps being folded inwardly over the same surface or opposite surfaces of the centre web.

30 12. A panel according to any one of claims 1 to 7, wherein said panel includes five rows of cells, corresponding cells of the first, third and fifth rows being laterally registered and corresponding cells of the second and fourth rows being laterally registered, and the cells of
35 the first, third and fifth rows being staggered

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longitudinally of said rows relative to the second and fourth rows, each of said folded strips comprising twelve width units, the centre web being about six width units, a first of said longitudinal flaps being about two width units and a second of said longitudinal flaps being about four width units, said and second longitudinal flaps being folded inwardly over the same surface or opposite surfaces of the centre web.

10 13. A panel according to any preceding claim, wherein said bond lines are adhesive lines.

14. A panel according to any preceding claim, including an elongated support strip and an opposing elongated stiffening strip, at least one of said support and stiffening strips including headed projections projecting toward the other strip of said support and stiffening strips and the other strip of said support and stiffening strips including openings formed therethrough registered with said projections and into which said projections are inserted and retentively retained by the heads thereon, at least one of said cells having said stiffening strip inserted therein, at least said one cell having wall openings formed therethrough through which said projections project.

25 15. A panel according to claim 14, wherein said panel includes three rows of cells consisting of two outside rows of cells and a centre row of cells therebetween corresponding cells of said outside rows of cells being laterally registered and the cells of said centre row of cells being staggered longitudinally of said rows relative to the cells of said outside rows of cells, said material strips each forming a pair of complete cells with the pair of cells formed by each material strip comprising

30 corresponding laterally registered cells of said outside

35





rows of cells and a centre row cell being formed between the pairs of cells of adjacent material strips, corresponding cells of said outside rows of cells having wall cuts formed therein opening into an adjacent centre row cell, said
5 stiffening strip being disposed lengthwise of said adjacent centre row cell.

16. A support system for supporting a vertically disposed multi cell panel including at least one row of
10 vertically superposed, horizontal tubular cells, said support system including an elongate support strip and an opposing elongate stiffening strip, at least one of said strips including headed projections projecting toward the other strip and the other strip including openings formed
15 therethrough registered with said projections and into which said projections may be inserted and retentively retained by the heads thereon, said stiffening member being adapted to be inserted into an upper cell of said multi cell panel after which, by movement of said strips toward each other,
20 said projections may pierce upper wall portions of the cell containing said stiffening strip and be projected into said openings.

17. A method of making an expandable and contractible
25 honeycomb panel including a plurality of parallel laterally adjacent rows of elongate tubular cells, said method comprising the steps of providing a continuous longitudinally extending length of a flat, foldable, creasable and drapable material, said material having a
30 first surface and an opposed second surface; forming a pair of longitudinally extending creases in said material thereby defining two longitudinal flaps and a central web portion of the material between said creases; folding said longitudinal flaps over said central web portion along said creases;
35 applying at least a first longitudinal glue line to the

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first surface of said material; applying a second longitudinal glue line and a third longitudinal glue line to said material, at least one of said second and third longitudinal glue lines being applied to the opposed second surface of said material; and stacking said folded material with the first, second and third longitudinal glue lines thereon such that said first longitudinal glue line secures one of said longitudinal flaps to the central web portion of the material and such that the second and third longitudinal glue lines secure the two flaps of said material to an adjacent length of said folded material.

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