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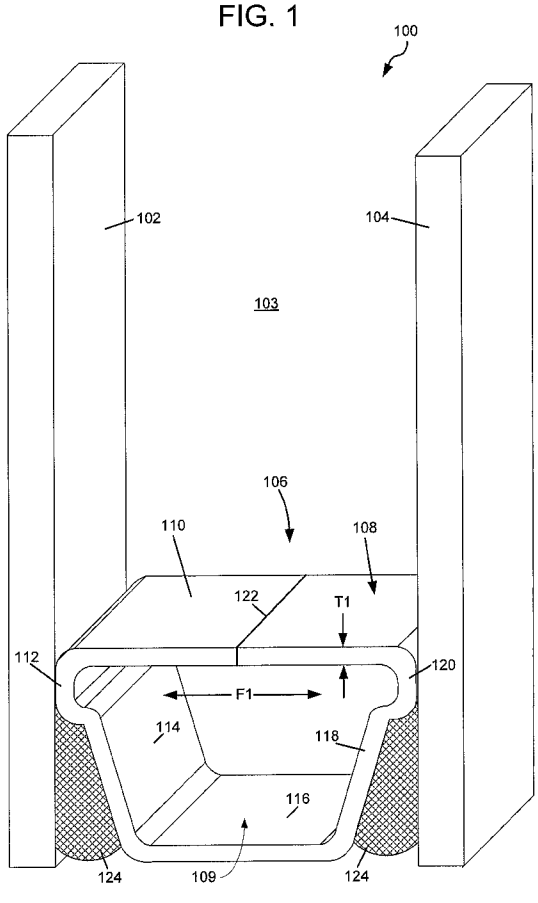
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(54) Title: REINFORCED WINDOW SPACER

FIG. 1



(57) Abstract: A window assembly includes a first sheet and a second sheet separated by a window spacer. A window spacer includes an elongate body bent to define an interior space. The window spacer has increased strength due to the presence of reinforcing features. One example of a reinforcing feature is a support member provided inside the window spacer. Another example of a reinforcing feature is an undulating shape formed into at least a portion of the elongate body. Methods of manufacturing window spacers are also disclosed.

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REINFORCED WINDOW SPACER

RELATED APPLICATIONS

This application is being filed on 13 November 2008, as a PCT International Patent application in the name of Infinite Edge Technologies, LLC, a U.S. national corporation, applicant for the designation of all countries except the U.S., and Paul Trpkovski, a citizen of the U.S., applicant for the designation of the U.S. only, and claims priority to U.S. Provisional Patent Application Serial No. 60/987,681 filed on 13 November 2007, U.S. Provisional Patent Application Serial No. 61/038,803 filed on 24 March 2008, U.S. Provisional Patent Application Serial No. 61/049,593 filed on 01 May 2008, and U.S. Provisional Patent Application Serial No. 61/049,599 filed on 01 May 2008.

BACKGROUND

Windows often include two facing sheets of glass separated by an air space. A spacer is typically arranged between the two facing sheets and at or near the outer periphery of the sheets. The spacer maintains the appropriate spacing between the two sheets, and seals the edges of the air space. The air space reduces heat transfer through the window to insulate the interior of a building from external temperature variations. As a result, the energy efficiency of the building is improved, and a more even temperature distribution is achieved within the building.

SUMMARY

In general terms, this disclosure is directed to a window assembly including a window spacer. In some embodiments, the window spacer includes features that provide increased strength and rigidity.

One aspect is a window spacer comprising an elongate body formed of at least one layer of a first material, the body defining an interior space and including a first side wall and an opposite second side wall; and a support member arranged within the interior space to provide support to the body.

Another aspect is a window assembly comprising a first sheet of an at least partially translucent or transparent material; a second sheet of the at least partially translucent or transparent material; and a spacer arranged between the first sheet and the second sheet, wherein the spacer comprises an elongate body defining an interior

space and including a first side portion connected to the first sheet and a second side portion connected to the second sheet; and a support member arranged within the interior space to provide support to the body.

A further aspect is a window spacer comprising an elongate body formed of at least one layer of a first material, the body defining an interior space and including a first side wall and an opposite second side wall, and wherein at least a portion of the body includes an undulating shape.

Yet another aspect is a method of manufacturing a window spacer, the method comprising obtaining an elongate strip of material; forming an undulating shape in the elongate strip of material; and bending the elongate strip of material after forming the undulating shape to form the window spacer.

A further aspect is a method of manufacturing a window spacer, the method comprising: obtaining a first elongate strip of a first material; obtaining a second elongate strip of a second material; bending the first elongate strip to define an interior space; arranging the second elongate strip within the interior space.

Another aspect is a method of manufacturing a window spacer, the method comprising: obtaining a first elongate strip of a first material; obtaining a second elongate strip of a second material; connecting the first elongate strip in a facing arrangement with the second elongate strip; bending the first elongate strip and the second elongate strip simultaneously to form the window spacer.

There is no requirement that an arrangement include all of the features characterized herein to obtain some advantage according to the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic perspective view of a portion of a window assembly including a window spacer according to the present disclosure.

FIG. 2 is a schematic cross-sectional view of another embodiment of the spacer shown in FIG. 1.

FIG. 3 is a schematic cross-sectional view of another exemplary embodiment of the spacer shown in FIG. 1.

FIG. 4 is a schematic cross-sectional view of another exemplary embodiment of the spacer shown in FIG. 1.

FIG. 5 is a schematic cross-sectional view of materials used to form another exemplary embodiment of the spacer shown in FIG. 1.

FIG. 6 is a schematic cross-sectional view of a spacer formed from the materials shown in FIG. 5.

FIG. 7 is a schematic cross-sectional view of a material layer that is used to form another exemplary embodiment of the spacer shown in FIG. 1.

FIG. 8 is a schematic plan view of a portion of the material layer shown in FIG. 7.

FIG. 9 is a schematic cross-sectional view of a material layer that is used to form another exemplary embodiment of the spacer shown in FIG. 1.

FIG. 10 is a schematic plan view of a portion of the material layer shown in FIG. 8.

DETAILED DESCRIPTION

Various embodiments will be described in detail with reference to the drawings, wherein like reference numerals represent like parts and assemblies throughout the several views. Reference to various embodiments does not limit the scope of the claims attached hereto. Additionally, any examples set forth in this specification are not intended to be limiting and merely set forth some of the many possible embodiments for the appended claims.

FIG. 1 is a schematic perspective view of a portion of a window assembly 100 according to the present disclosure. Window assembly 100 includes sheet 102, sheet 104, spacer 106, and sealant 124. Window assembly 100 defines an interior space 103. Spacer 106 includes body 108 and defines an interior space 109. Body 108 includes inner portion 110, inner side portion 112, outer side portion 114, outer portion 116, outer side portion 118, and inner side portion 120. In some embodiments, interior space 109 is filled with a filler 126 (such as shown in FIG. 2).

Sheets 102 and 104 are typically formed of a material such as glass or plastic that allows at least some light to pass through. Some embodiments include an at least partially translucent or transparent material, while other embodiments include a substantially transparent material. Examples of suitable materials for sheets 102 and 104 are glass and plastic, or combinations of glass and plastic.

Spacer 106 is arranged between sheet 102 and sheet 104 to maintain sheet 102 in a spaced relationship with sheet 104. Spacer 106 together with sheets 102 and 104 define interior space 103, which is a sealed interior region of window assembly 100. Interior space 109 typically includes interior space 103 because joint

122 is formed with holes or a gap that allows air and moisture to pass through. Sealant 124 is used to seal the intersection between sheet 102 and spacer 106 and to seal the intersection between sheet 104 and spacer 106. In some embodiments, one or more additional sealant or adhesive layers are arranged between spacer 106 and sheets 102 and 104 (such as between inner side portion 112 and sheet 102 and between inner side portion 120 and sheet 104) to connect and seal spacer 106 with sheets 102 and 104.

Body 108 includes inner portion 110, inner side portion 112, outer side portion 114, outer portion 116, outer side portion 118, and inner side portion 120. Inner portion 110 is connected between inner side portions 112 and 120. Inner side portion 112 is connected between inner portion 110 and outer side portion 114. Inner side portion 120 is connected between inner portion and outer side portion 118. Outer portion 116 is connected between outer side portion 114 and outer side portion 118. Corners are formed between respective portions of body 100.

In some embodiments, body 108 is formed of a single sheet of material. Examples of suitable materials include metal and plastic, having a material thickness T1. The material is first obtained in an elongated strip form and is subsequently bent into the desired shape, such as using a roll former. The elongated strip material typically has a length in a range from about 50 inches to about 250 inches, although other lengths are used in other embodiments. The elongated strip is passed through a roll former that bends the elongated strip to form corners between portions of spacer 106, and any other desired features of spacer 106. Edges of the elongated strip are joined together at joint 122 by any suitable means, such as by welding, gluing, fastening, and the like. Edges are slightly overlapped in some embodiments to improve the strength of joint 122. In some embodiments holes are formed at joint 122 to allow gas and moisture to communicate between interior space 109 and the rest of interior space 103.

Due to the relatively long length of spacer 106, rigidity and strength of spacer 106 is important. For example, when installing a spacer into a particular window, an end of the spacer is often inserted into a die to bend the spacer to match the windows shape. In doing so, a majority of the spacer is often suspended in the air. If a spacer is not rigid enough to support its own weight, the spacer will be damaged when it bends under the weight. A damaged spacer is typically discarded

as waste. Therefore, embodiments of spacer 106 include features that provide adequate rigidity or strength to resist damage during manufacture and use.

After spacer 106 has been formed, a sealant 124 is applied between spacer 106 and sheets 102 and 104 to seal edges of window assembly 100. Examples of sealant 124 include polyisobutylene (PIB), butyl, curable PIB, holt melt silicon, acrylic adhesive, acrylic sealant, reactive hot melt butyl (such as D-2000 manufactured by Delchem, Inc. located in Wilmington, DE), curative hot melt (such as HL-5153 manufactured by H.B. Fuller Company), silicon, copolymers of silicon and polyisobutylene, and other Dual Seal Equivalent (DSE) type materials.

When forces are applied to sheets 102 and 104 in the direction F1, the forces are transferred through sheets 102 and 104 to spacer 106. Spacer 106 applies an approximately equal and opposite force to the respective window sheet to maintain window sheets 102 and 104 appropriately spaced apart. As a result, interior space 103 continues to provide reduced thermal conductivity between sheets 102 and 104.

In some embodiments, a filler 126 (such as shown in FIG. 2) is placed within interior space 109 of spacer 106. An example of a suitable filler material is a desiccant that acts to remove moisture from the interior space of window assembly 100. Desiccants include molecular sieve and silica gel type desiccants. One particular example of a desiccant is a beaded desiccant, such as PHONOSORB ® molecular sieve beads manufactured by W. R. Grace & Co. of Columbia, MD. If desired, an adhesive is used to attach beaded desiccant between elongate strips 110 and 114. Other examples of filler materials include an adhesive, foam, putty, resin, silicon rubber, or other material or combination of materials.

In other embodiments, filler 126 (shown in FIG. 2) is a material that provides added support to spacer 106 to provide increased structural strength. The structural strength is increased because the filler resists compression and buckling of body 108. In this way, spacer 106 does not rely solely on the structural strength of body 108. In some embodiments, the added strength provided by the filler enables spacer 106 to be formed using a thinner material for body 108, without reducing the overall strength of spacer 106. Thinner material reduces heat transfer through the material (such as between sheets 102 and 104) and also reduces the amount of material required to make body 108, thereby reducing the cost of body 108.

In yet other embodiments, filler 126 is a matrix desiccant material that both provides structural support to body 108 and also removes moisture from the interior

space of window assembly 100. Some filler materials are a desiccant or include a desiccant, such as a matrix material. Matrix material includes desiccant and other filler material. Examples of matrix desiccants include those manufactured by W.R. Grace & Co. and H.B. Fuller Corporation. A beaded desiccant can also be combined with another filler material, if desired.

FIG. 2 is a schematic cross-sectional view of another embodiment of window spacer 106. Spacer 106 includes body 108 including inner portion 110, inner side portion 112, outer side portion 114, outer portion 116, outer side portion 118, and inner side portion 120. Spacer 106 also includes support member 128.

When a force is applied to window spacer 106, the majority of the force is typically applied in direction F1 (shown in FIG. 1). The force is resisted by spacer 106, which applies an approximately equal and opposite force to maintain the sheets appropriately spaced apart. Some of the force is supplied by inner portion 110 and inner side portions 112 and 120. Although inner portion 110 is shown as being substantially planar, other embodiments include non-planar shapes. Additional force is supplied through outer portion 116, outer side portions 114 and 118, and inner side portions 112 and 120.

In this embodiment, window spacer 106 further includes support member 128. Support member 128 is arranged within body 108, and extends generally between inner side portion 112 and inner side portion 120. Support member provides additional strength to window spacer 106 to assist body 108 in withstanding forces applied by sheets 102 and 104 (shown in FIG. 1) in direction F1.

In some embodiments, support member 128 is a fibrous material, such as paper, paperboard, cardboard, carbon fiber, wood, or other fibrous materials. An advantage of such materials is that they are breathable, such that they do not block the flow of air and moisture through joint 122 or other holes in spacer 106. In other embodiments, support member 128 is a laminate of two or more materials. A composite material is used in some embodiments. Adhesive, such as epoxy, is suitable in some embodiments to connect two or more layers together. Yet other embodiments include biaxially-oriented polyethylene terephthalate polyester film (such as Mylar ® brand film). Holes can be formed in such embodiments to improve the ability of the material to pass air and moisture, if desired.

In some embodiments, support member 128 is a long strip of material. For example, support member 128 is typically in a range from about 50 inches to about

250 inches, although other lengths are used in other embodiments. Support member 128 can be inserted within body 108 before body 108 is bent into the desired shape, or alternatively can be inserted through an open end of body 108 after body 108 is formed, and slid through body 108 until it is in the desired position. In some embodiments an adhesive is used to connect support member 128 with body 108.

The added strength provided by support member 128 increases the strength of spacer 106 in some embodiments. In other embodiments, the presence of support member 128 reduces the strength requirements of body 108. As a result, the thickness of body 108 material can be reduced, which reduces the overall amount of material needed to construct body 108. Reduced material leads to reduced material costs and reduced weight. In some embodiments, support member 128 is made of a material that is less expensive than the material of body 108, such that the overall material costs are reduced despite the added cost of support member 128 material.

Reduced thickness of body 108 material also has the further advantage of improving thermal properties of spacer 106. The thinner the material of body 108, the less heat transfer occurs through body 108 between sheet 102 and sheet 104.

Another advantage of some embodiments is that support member 128 fills some of the space within body 108, such that less filler 126 is needed to fill the space surrounded by body 108. If the material cost of support member 128 is less than the cost of filler material, the overall material cost is further reduced. In addition, some embodiments include a support member 128 that is less weight per unit volume than filler 126. As a result, the overall weight of spacer 106 is reduced.

In another possible embodiment, rather than reducing the thickness of body 108 material, a different material is used that could not otherwise have been used. The material has improved characteristics, such as better thermal properties, reduced cost, or other beneficial characteristics.

FIG. 3 is a schematic cross-sectional view of another exemplary embodiment of spacer 106. Spacer 106 includes body 108 including inner portion 110, inner side portion 112, outer side portion 114, outer portion 116, outer side portion 118, and inner side portion 120. Spacer 106 also includes support member 128 and support member 130.

When a force is applied to spacer 106 (e.g., a force in direction F1, shown in FIG. 1) between inner side 112 and inner side 120, the force is resisted by an approximately equal and opposite force. This equal and opposite force is applied to

the sheets from body 108 and strength member 128. However, the force becomes too large, inner portion 110 may begin to buckle, such as by moving toward outer portion 116. Such movement is resisted in this embodiment by the addition of a second support member 130 that extends between support member 128 and outer portion 116. In some embodiments strength members 128 and 130 are formed of a single strip of material that is bent into the desired shape, such as a "T" shape. Other embodiments are formed of multiple materials that are fastened together at a joint. Yet other embodiments include a filler material on both open sides of support member 130 that maintains support member 130 in the illustrated (or other desired) orientation.

Other embodiments include additional support members, and some embodiments include other configurations of support members. As one example, support member 130 is replaced by a V-shaped or triangular support member. The support member extends from the midpoint of support member 128 to the corner between lower side portion 114 and outer portion 116, and also from the midpoint of support member 128 to the corner between outer side portion 118 and outer portion 116. Other examples included a cylindrical, outer portion square, or rectangular, support members. Other embodiments include other shapes, sizes, numbers, and configurations of support members.

FIG. 4 is a schematic cross-sectional view of another exemplary embodiment of spacer 106. Spacer 106 includes body 108 including inner portion 110, inner side portion 112, outer side portion 114, outer portion 116, outer side portion 118, and inner side portion 120. Spacer 106 also includes support member 140.

Support member 140 includes segments 142, 144, and 146. Segment 144 is adjacent and generally parallel with outer portion 116. Segment 142 extends from one side of segment 144, and generally parallel with outer side portion 114. Segment 146 extends from an opposite side of segment 144, and generally parallel with outer side portion 118. Support member 140 provides additional support to adjacent portions of body 108.

In one embodiment, support member 140 is made of a single strip of material that is bent to form corners between adjacent segments. In some embodiments, support member 140 and body 108 are formed of planar elongated strips that are fastened together prior to bending. After fastening, support member 140 and body 108 are bent simultaneously. In other embodiments, support member 140 is bent

separately and then inserted into body 108. Examples of suitable materials for support member 140 are described above. Filler is inserted into interior space 109 in some embodiments.

FIG. 5 is a schematic cross-sectional view of materials used to form another exemplary embodiment of a spacer. Spacer 106 includes support layer 150 and body layer 152. Support layer 150 and body layer 152 are in facing arrangement to each other. Support layer 150 is a material that provides additional support to body layer 152. Examples of suitable materials for support layer 150 include those described, is suitable for support members discussed above. In some embodiments, support layer 150 is fastened to body layer 152, such as with an adhesive or other fastener. In one example, embodiment body layer 152 is stainless steel and support layer 150 is biaxially-oriented polyethylene terephthalate polyester film. A MYLAR ® core laminate spacer is then formed as shown in Fig. 6.

After formation and arrangement of layers 150 and 152, the layers are bent into the desired shape of spacer 106, as shown in FIG. 6.

FIG. 6 is a schematic cross-sectional view of another exemplary embodiment of a spacer 106 after bending of the material layers shown in FIG. 5. Spacer 106 includes body 108 including inner portion 110, inner side portion 112, outer side portion 114, outer portion 116, outer side portion 118, and inner side portion 120. Body 108 is formed of body layer 152. Spacer 106 also includes support member 140 arranged adjacent to a surface of body layer 152.

After forming and arranging layers 150 and 152 as shown in FIG. 5, layers 150 and 152 are bent, such as using one or more roll formers. Support layer 150 provides added strength to spacer 106, providing various advantages as described herein.

FIGS. 7 and 8 illustrate a material layer 170 that can be used to form another exemplary embodiment of a spacer. FIG. 7 is a schematic cross-sectional view of material layer 170. FIG. 8 is a schematic plan view of a portion of material layer 170.

Material layer 170 is a relatively long and narrow strip of one or more layers. Material 170 has an undulating shape. An example of an undulating shape is a sinusoidal shape. Other examples of undulating shapes include triangular-wave, square-wave, or other shapes having a repeating or non-repeating pattern. Material layer 170 is a material such as metal or plastic that can be formed to have an

undulating shape. In one example, the undulating shape is formed in a planar strip of material by bending, such as using a roll former to impress the undulating pattern into the strip of material. In another embodiment, the undulating shape is formed by molding or melting the material into the desired undulating shape.

In some embodiments, the undulating pattern has small undulations in a range from about 10 to about 100 peaks per inch. In other embodiments, the undulating pattern has larger undulations, such as from about 0 to about 10 undulations per inch. The peak to peak amplitude of the undulations are typically in a range from about 0.01 inches to about 0.2 inches. In other embodiments, the peak to peak amplitude of the undulations are in a range from about 0.1 inches to about 0.5 inches.

After material layer 170 has been formed, material layer 170 is bent into the desired spacer configuration. The undulations present in material layer 170 are advantageous to the spacer. In some embodiments, the undulations provide increased strength along a longitudinal direction, increasing the rigidity of spacer 106 to resist buckling, kinking, or other damage to the spacer.

In some embodiments, the undulations also cause material layer 170 to have increased flexibility in a lateral direction. This is beneficial, for example, to make material layer 170 bend more easily when forming into the desired spacer configuration. Although the embodiments of Figs. 7-8 illustrate longitudinal undulations, another embodiment includes lateral or angled undulations.

FIGS. 9 and 10 illustrate a material layer 190 that can be used to form another exemplary embodiment of a spacer. FIG. 9 is a schematic cross-sectional view of material layer 190. FIG. 10 is a schematic plan view of a portion of material layer 190.

Material layer 190 is a relatively long and narrow strip of one or more layers and includes three distinct regions: region 192, region 194, and region 196. Each region has an undulating shape. In this example, regions 192 and 196 have undulations that extend longitudinally along material layer 190 and region 194 has undulations that extend laterally along material layer 190 between regions 192 and 196.

Material layer 190 is a material such as metal or plastic. In one example, the undulating shapes are formed in a planar material strip by bending the metal strip, such as by passing the material strip through two or more adjacent rollers. The

rollers have a shape that cause the material strip to bend as it passes between the rollers. As a result, an undulating shape is formed. In this embodiment, the rollers have multiple regions having different shapes, each region of the roller is used to form one of regions 192, 194, and 196. Alternatively, multiple rollers are used to form the regions in separate steps. Further, other embodiments for undulations in other ways, such as by molding material layer 190 in a mold to form the desired undulating pattern.

After material layer 190 has been formed to include the desired undulating shape, material layer 190 is then bent into the desired spacer shape, such as the shape illustrated in FIG. 1. In this embodiment, region 194 is used to form the outer portion 116 and regions 192 and 196 are used to form the other portions of body 108. (See FIG. 1.)

In some embodiments, region 194 includes lateral undulations that increase the flexibility of outer portion 116 to resist kinking, bending, buckling, cracking or other damage. Regions 192 and 196 include longitudinal undulations. The longitudinal undulations provide added strength and stability in the longitudinal direction, increasing the rigidity of spacer 106 in this dimension. This improves spacer 106 by, for example, making spacer 106 easier to manipulate and handle during manufacturing without damaging to spacer 106. On the other hand, added flexibility is added in other dimensions of spacer 106, such as making spacer 106 easier to bend into the desired shape (such as the shape shown in FIG. 1).

Other embodiments include other undulating patterns, combinations of undulating regions, or combinations of undulating regions and planar regions. For example, any of regions 192, 194, and 196 could alternatively be formed to have a planar shape, where one or more of the other regions have an undulating shape. Additional regions are included in some embodiments, which have either an undulating shape or a non-undulating shape.

Although spacer 106 has been described as having a particular general body structure, as shown in FIG. 1, other embodiments include other spacer shapes and configurations. For example, a simple box shape is used in some embodiments having a square or rectangular cross-sectional shape. In another embodiment, a spacer has a three-sided cross-sectional shape, such as arranged in a U-shape. Yet other embodiments include additional features to that shown in FIG. 1, such as including additional wings or protrusions. The protrusions are useful, for example,

to provide additional surface area for adhering spacer 106 to sheets 102 and 104. Further, the embodiment of FIG. 1 illustrates portions having generally planar shapes. Other embodiments include portions with non-planar shapes. Some embodiments include conventional box spacers.

The various embodiments described above are provided by way of illustration only and should not be construed to limit the claims attached hereto. Those skilled in the art will readily recognize various modifications and changes that may be made without following the example embodiments and applications illustrated and described herein, and without departing from the intended scope of the following claims.

WHAT IS CLAIMED IS:

1. A window spacer comprising:
an elongate body formed of at least one layer of a first material, the body defining an interior space and including a first side wall and an opposite second side wall; and
a support member arranged within the interior space to provide support to the body.

2. The window spacer of claim 1, wherein the first material is selected from the group consisting of metal and plastic.

3. The window spacer of claim 2, wherein the first material is stainless steel.

4. The window spacer of claim 1, wherein the support member is an elongate strip of a second material, and wherein the support member extends between the side walls.

5. The window spacer of claim 4, wherein the second material is a fibrous material, biaxially-oriented polyethylene terephthalate, or a combination of fibrous material and biaxially-oriented polyethylene terephthalate.

6. The window spacer of claim 4, wherein the second material includes a material selected from the group consisting of: paper, paperboard, cardboard, card stock, and biaxially-oriented polyethylene terephthalate.

7. The window spacer of claim 4, wherein the second material is a laminate or a composite.

8. The window spacer of claim 4, wherein the body includes an inner surface that is connected between the sidewalls and wherein the support member is substantially parallel with at least a majority of the inner surface.

9. The window spacer of claim 8, wherein the window spacer further comprises a second support member.

10. The window spacer of claim 9, wherein the body further comprises an outer surface opposite the inner surface, and wherein the second support member extends from the support member to the outer surface.

11. A window assembly comprising:
a first sheet of an at least partially translucent or transparent material;
a second sheet of the at least partially translucent or transparent material; and
a spacer arranged between the first sheet and the second sheet, wherein the spacer comprises:
an elongate body defining an interior space and including a first side portion connected to the first sheet and a second side portion connected to the second sheet; and
a support member arranged within the interior space to provide support to the body.

12. The window assembly of claim 11, wherein the support member is a substantially planar elongate strip extending between the first side portion and the second side portion.

13. The window assembly of claim 11, wherein the support member has a T-shaped cross-section.

14. The window assembly of claim 11, wherein the support member has a U-shaped cross-section.

15. The window assembly of claim 11, wherein the support member is a laminate arranged along at least part of an interior surface of the body.

16. A window spacer comprising an elongate body formed of at least one layer of a first material, the body defining an interior space and including a first side wall

and an opposite second side wall, and wherein at least a portion of the body includes an undulating shape.

17. The window spacer of claim 16, wherein the undulating shape includes at least ten undulations per inch.

18. The window spacer of claim 17, wherein the undulating shape includes less than 100 undulations per inch.

19. The window spacer of claim 16, wherein the undulating shape has a peak to peak amplitude in a range from about 0.01 inches to about 0.1 inches.

20. The window spacer of claim 16, wherein the elongate body further comprises a first region having a first undulating shape and a second region having a second undulating shape that is different than the first undulating shape.

21. The window spacer of claim 20, wherein the elongate body further comprises a third region having the first undulating shape.

22. The window spacer of claim 21, wherein the second region is between the first region and the third regions.

23. A method of manufacturing a window spacer, the method comprising:
obtaining an elongate strip of material;
forming an undulating shape in the elongate strip of material; and
bending the elongate strip of material after forming the undulating shape to form the window spacer.

24. A method of manufacturing a window spacer, the method comprising:
obtaining a first elongate strip of a first material;
obtaining a second elongate strip of a second material;
bending the first elongate strip to define an interior space;
arranging the second elongate strip within the interior space.

25. A method of manufacturing a window spacer, the method comprising:

obtaining a first elongate strip of a first material;

obtaining a second elongate strip of a second material;

connecting the first elongate strip in a facing arrangement with the second elongate strip;

bending the first elongate strip and the second elongate strip simultaneously to form the window spacer.

FIG. 1

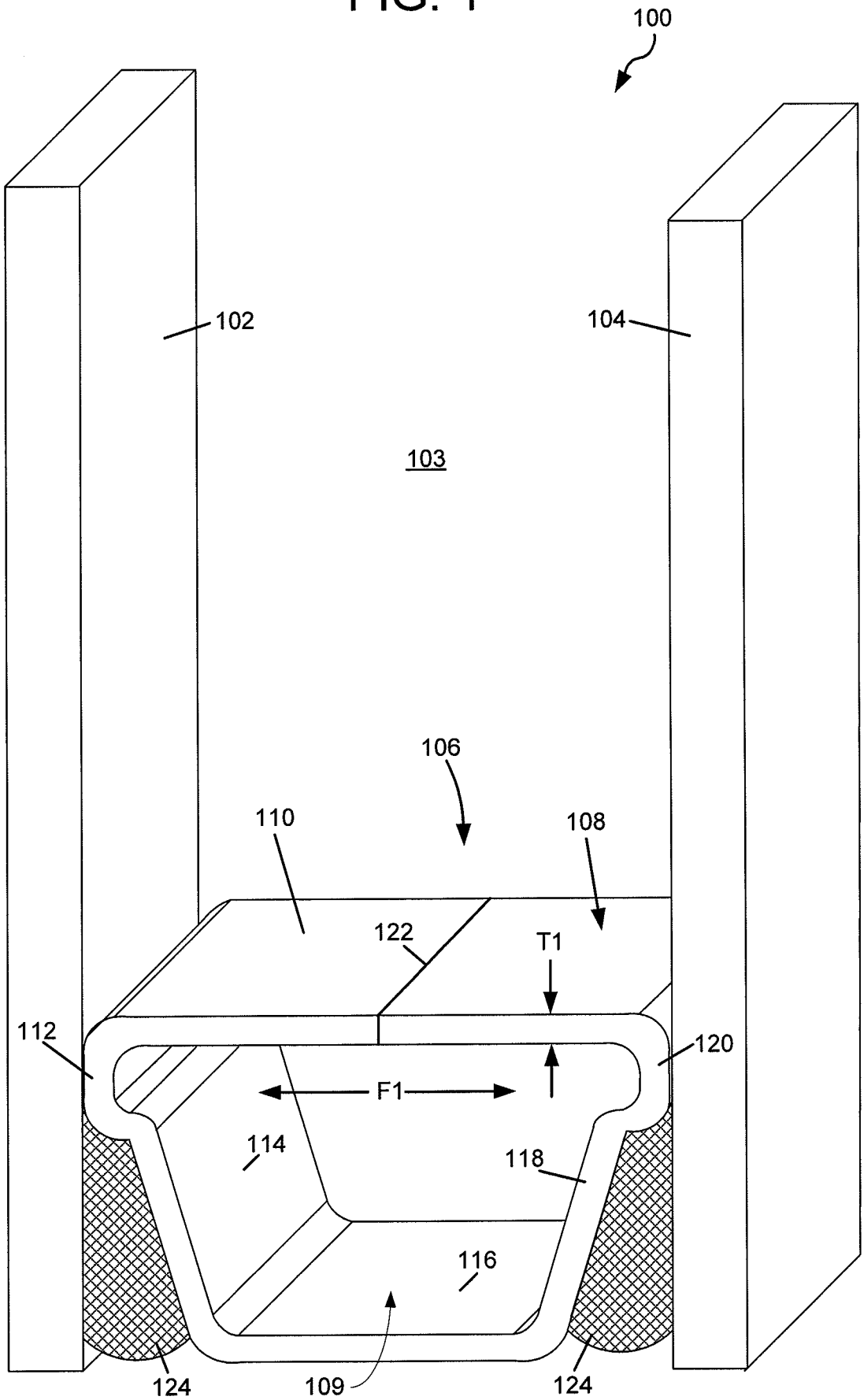

100
102
104
103
106
110
108
122
T1
112
120
F1
114
118
116
124
109
124

FIG. 2

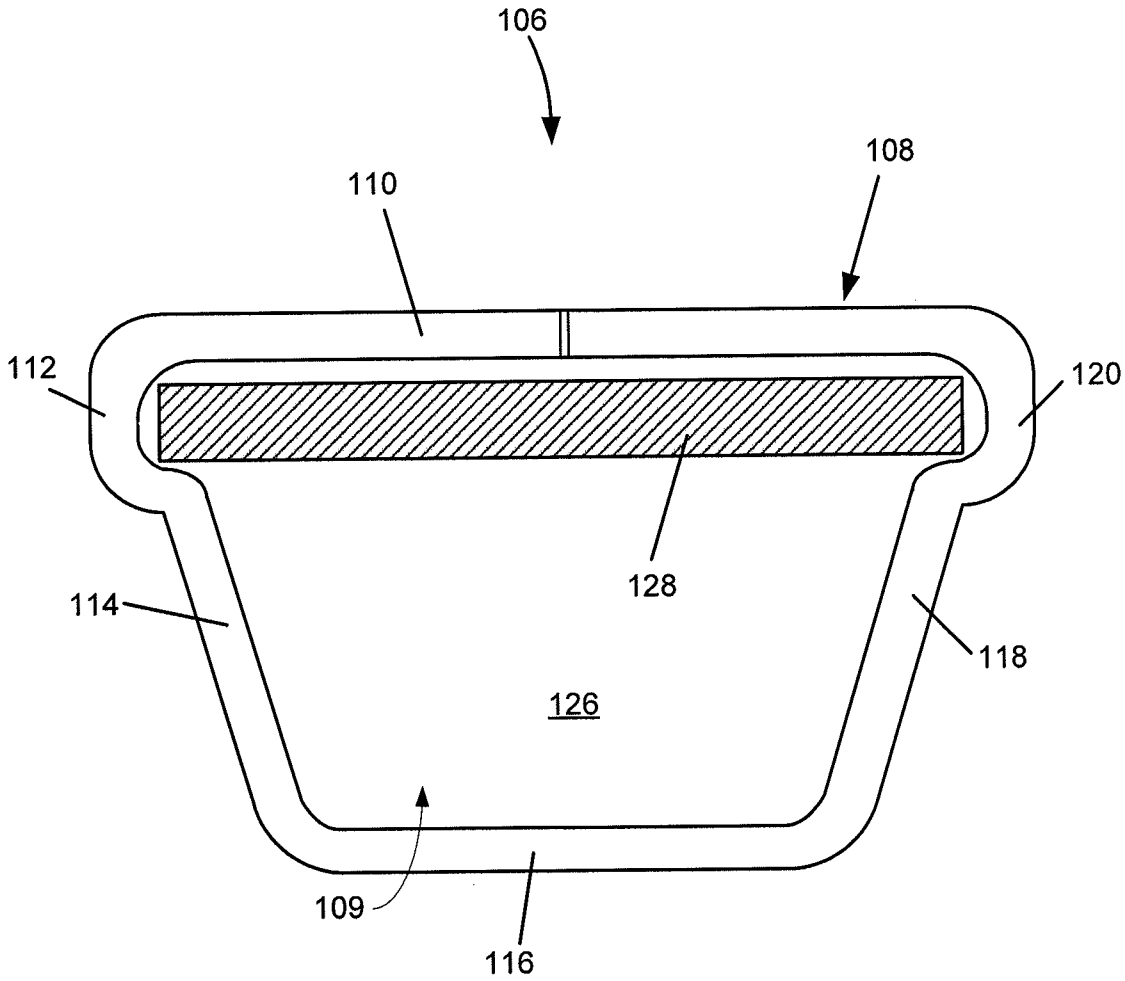


FIG. 3

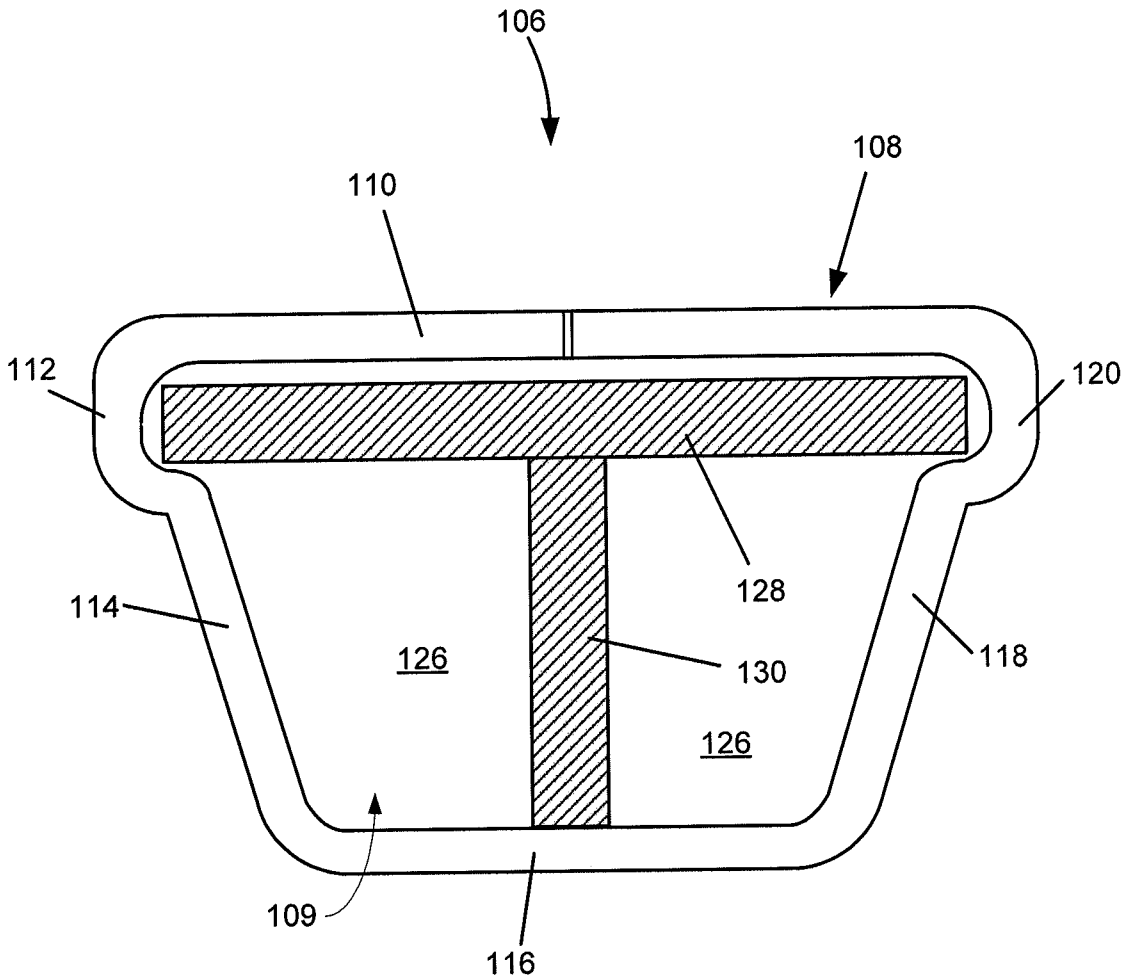


FIG. 4

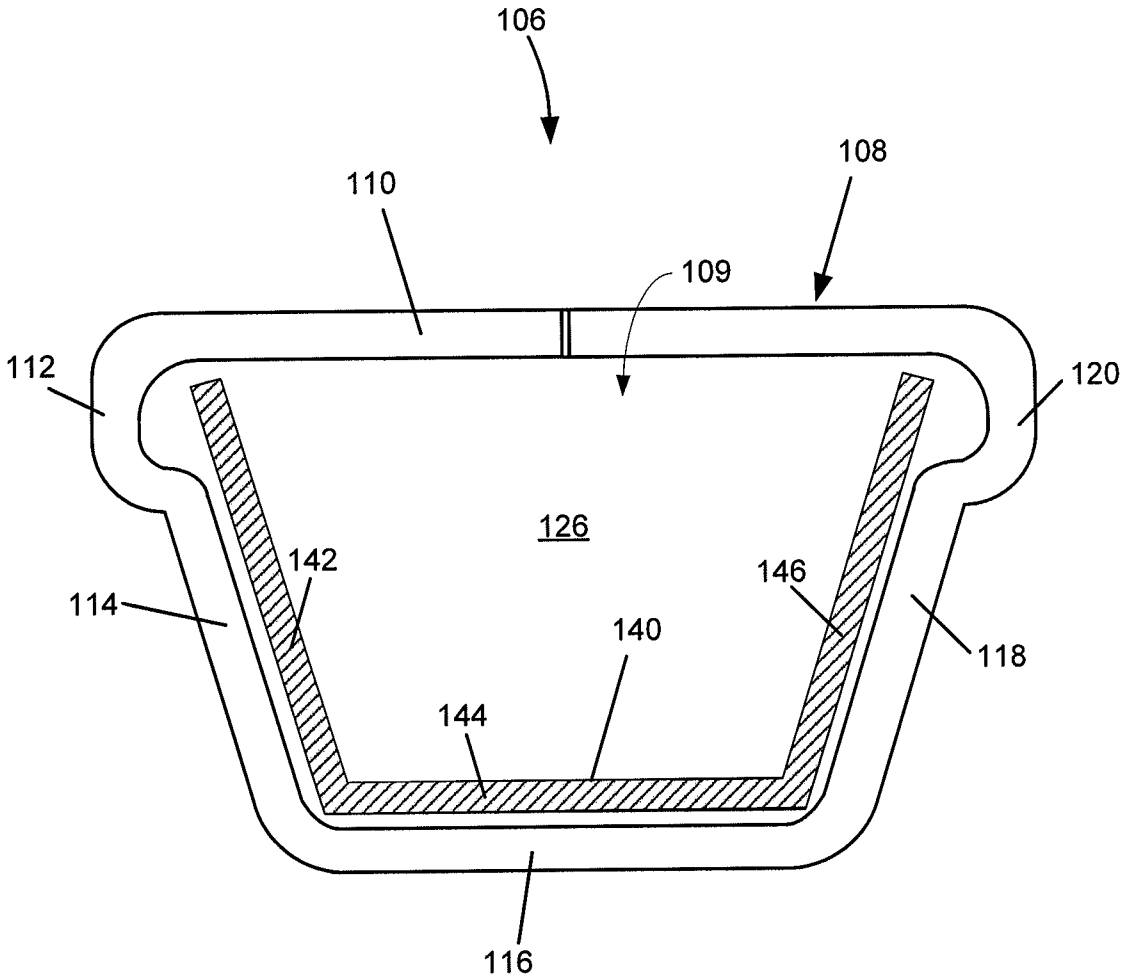


FIG. 5

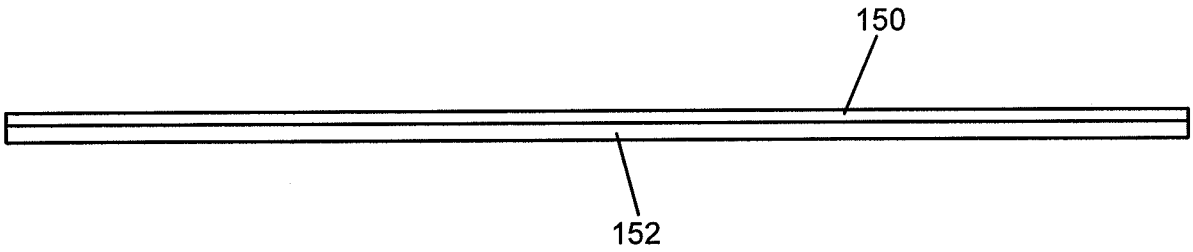


FIG. 6

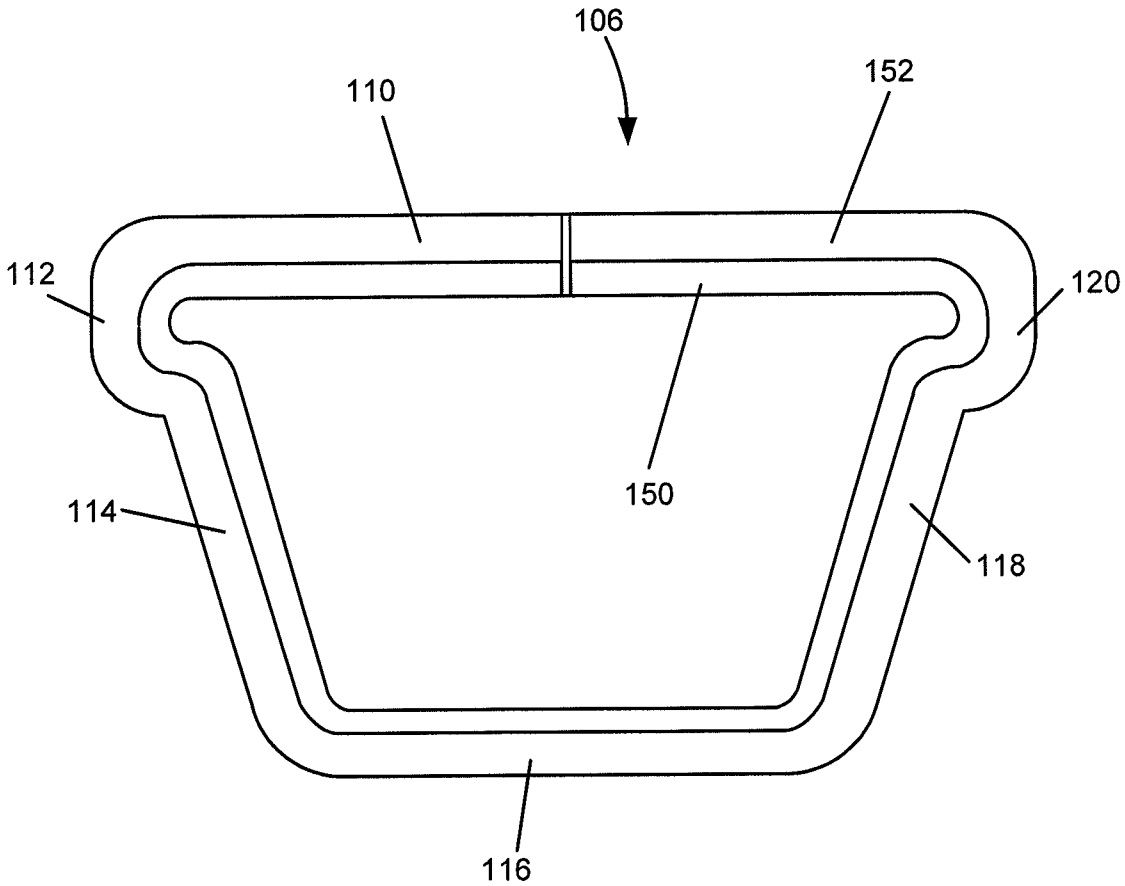


FIG. 7



FIG. 8

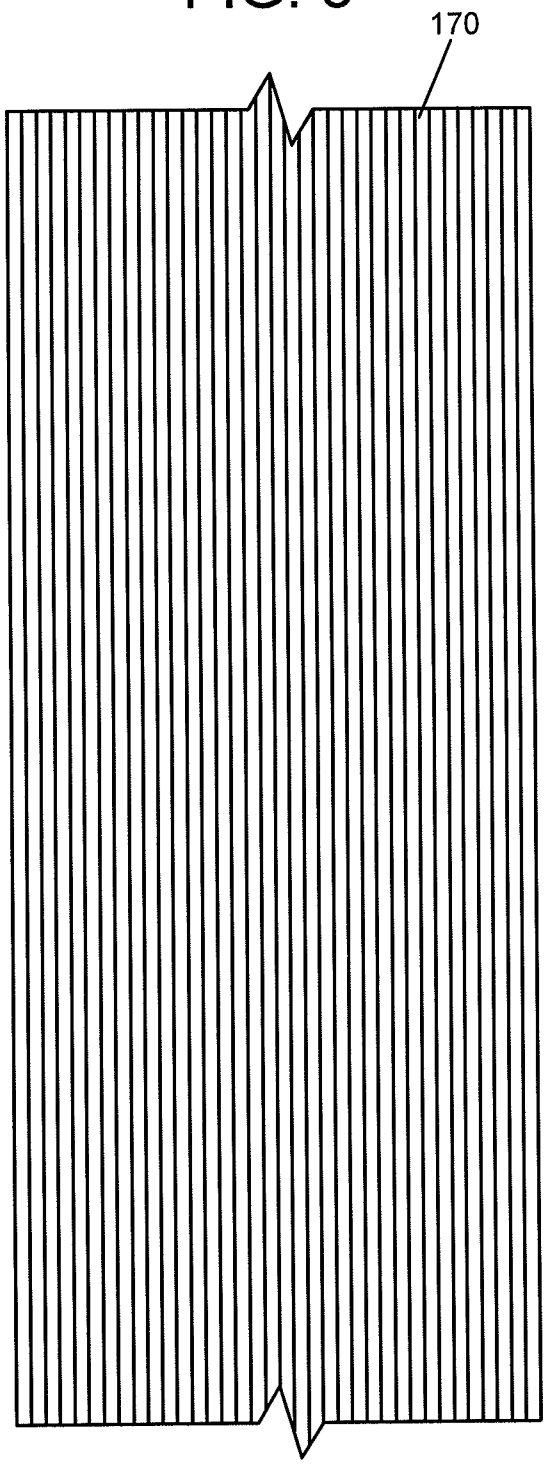


FIG. 9

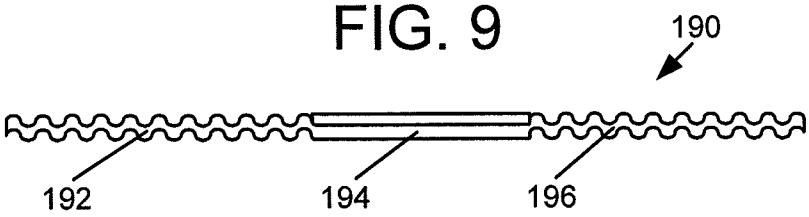
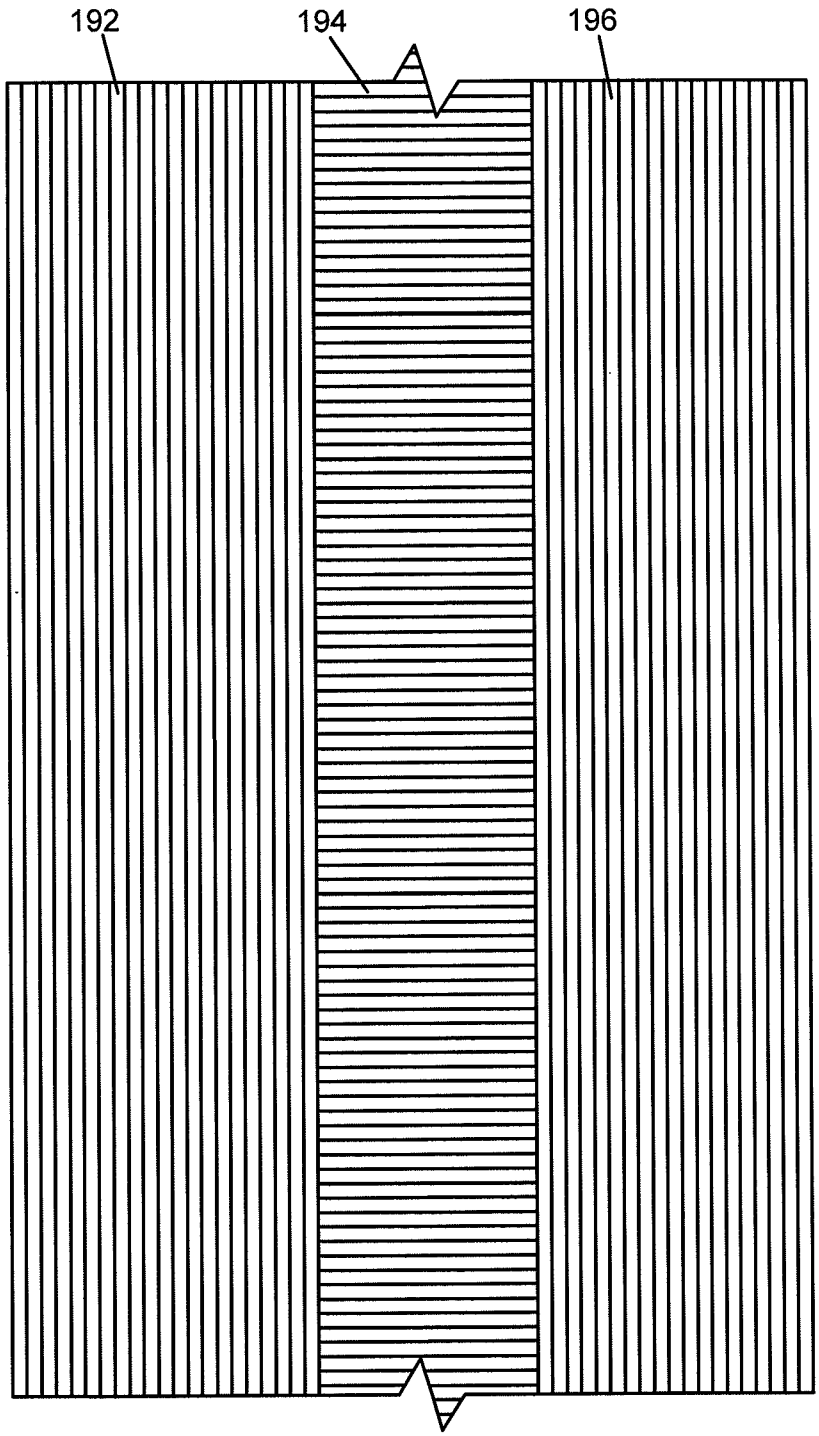


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/083441

A. CLASSIFICATION OF SUBJECT MATTER
INV. E06B3/663

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)
E06B

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 579 726 A (PILKINGTON BROTHERS LTD) 26 November 1980 (1980-11-26) figure 1	1,2,4,8, 11,12
X	US 5 714 214 A (LARSEN JAMES E [US]) 3 February 1998 (1998-02-03) figure 6	1-4,8, 11,12,24
X	US 4 113 905 A (KESSLER GERALD) 12 September 1978 (1978-09-12) figure 1	1,2,4,8, 11,12, 23,25
X	US 2003/074859 A1 (REICHERT GERHARD [US] ET AL) 24 April 2003 (2003-04-24) figure 19	1,2,4-6, 8,11,14, 16,19,25

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
14 January 2009	22/01/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Verdonck, Benoit

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/083441

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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X	GB 2 389 138 A (PETERSON WALLACE HARVEY [US]) 3 December 2003 (2003-12-03) figure 8	16
X	WO 2004/009944 A (LAFOND LUC MARCEL [CA]) 29 January 2004 (2004-01-29) figure 3	16

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Information on patent family members

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