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E04C 2/52

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E1D DCF2 DF116 D1079 D154 D2141 D401 D424 D547

(56) Documents Cited
US 4807405 A **US 4773190 A**

(58) Field of Search
UK CL (Edition T) **E1D** DCF DF116
INT CL[7] **E04C**
Other: **ONLINE: EPODOC, PAJ, WPI**

(54) Abstract Title
An inflatable panel

(57) A building component for forming a roof comprises a rigid frame 15 which surrounds and supports two or more sheets of plastics foil 12, 13, 14 . The sheets form a cushion 11 which is inflatable via a plenum 16. Liquid retaining means 17 for suppressing rain noise is applied to the outermost sheet 12 of the cushion and preferably comprises a woven material, a net or a sheet. The liquid retaining means 17 may be fixed to the frame 15 or alternatively to the outermost sheet 12 forming a water tight compartment (53 fig. 5) filled with water via a hose (59 fig. 5).

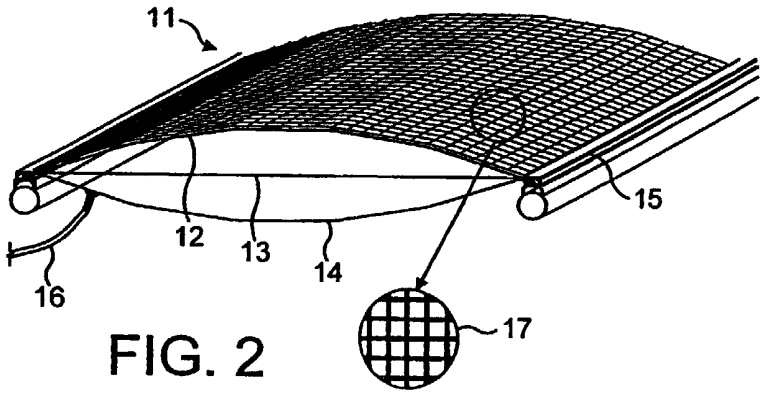

FIG. 2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

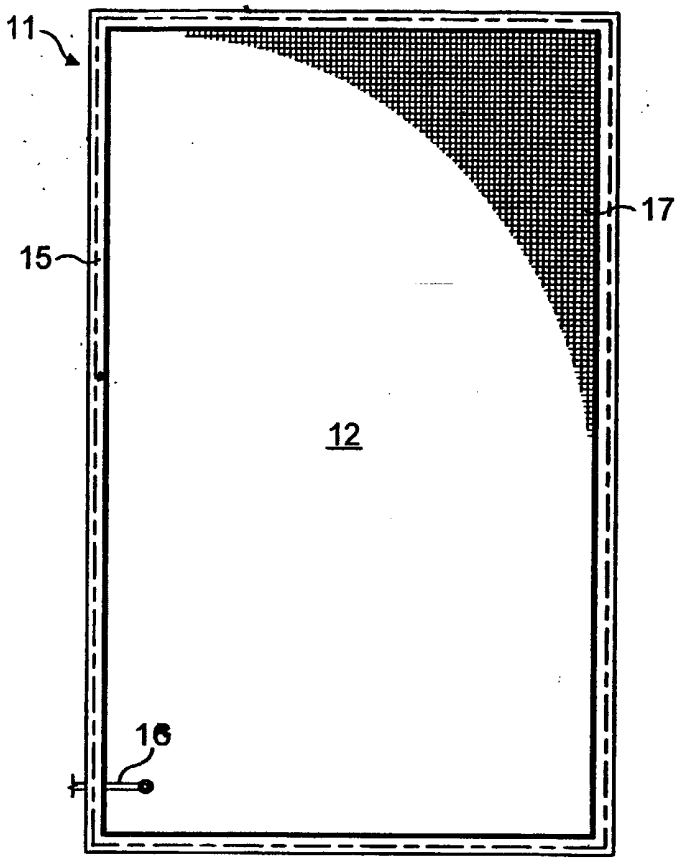

FIG. 1

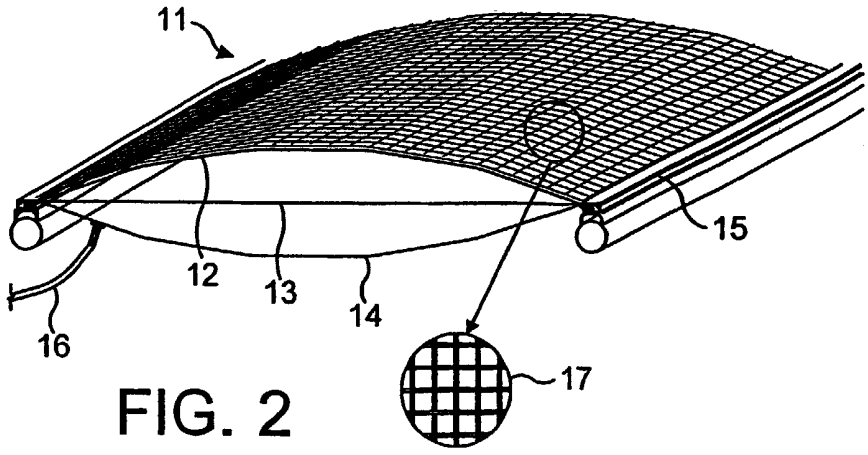

FIG. 2

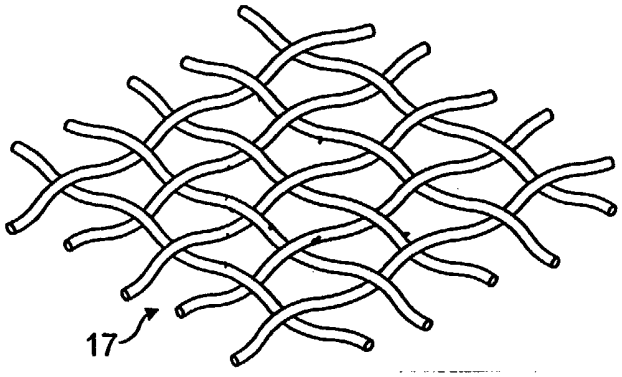

FIG. 3A

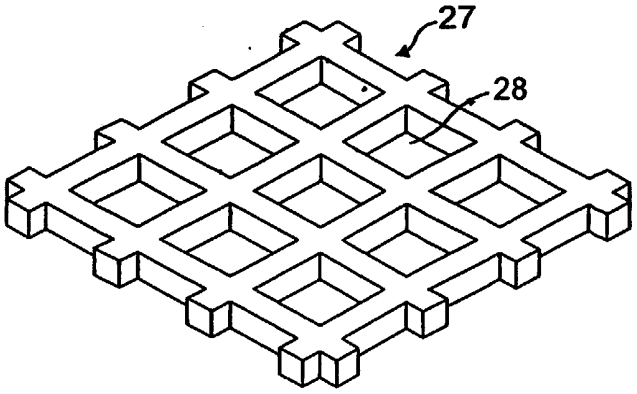

FIG. 3B

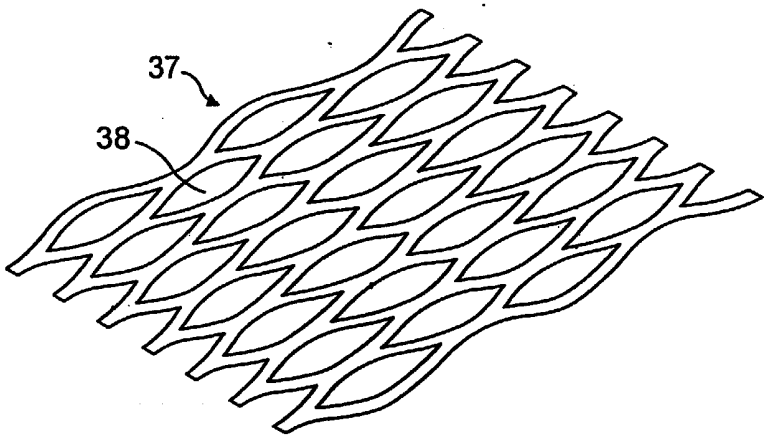

FIG. 3C

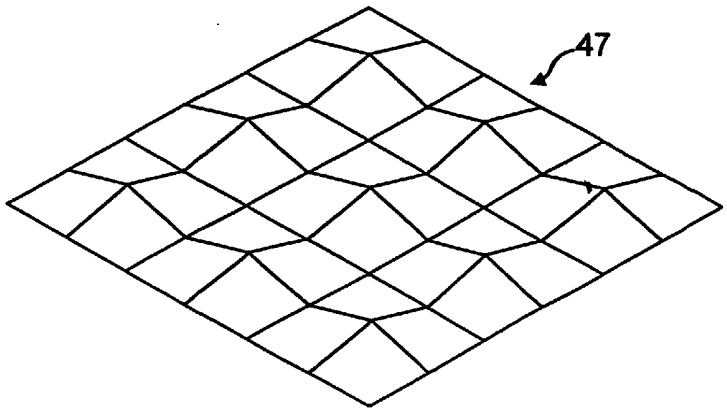

FIG. 3D

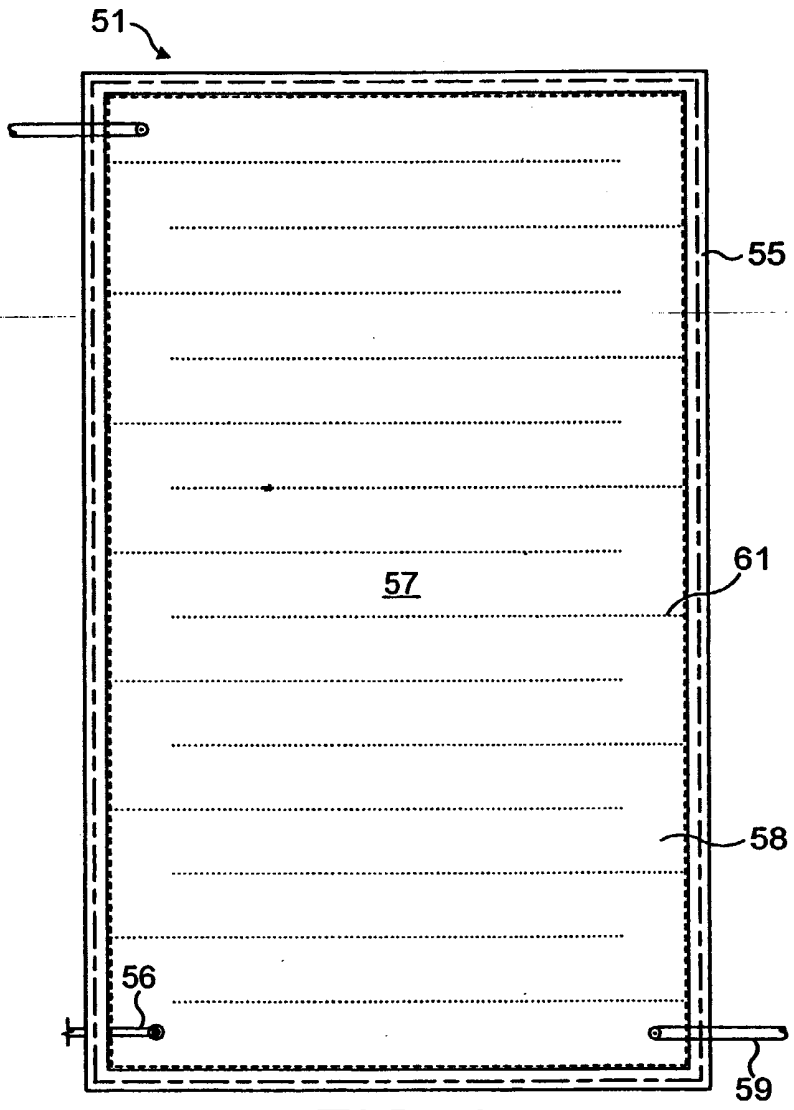

FIG. 4

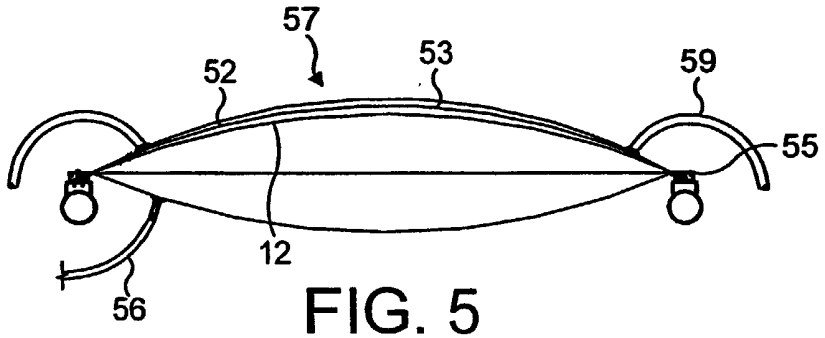

FIG. 5

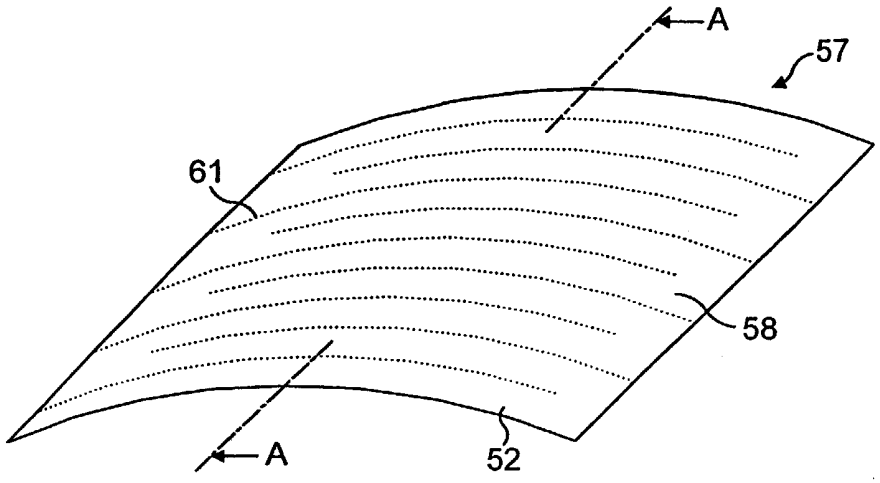

FIG. 6

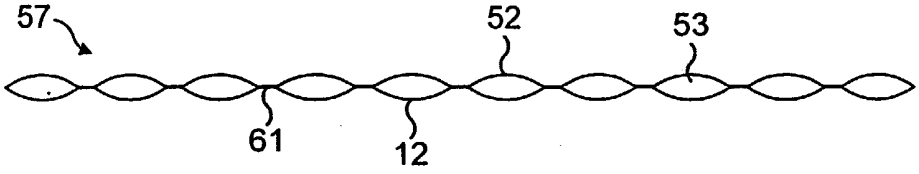

FIG. 7

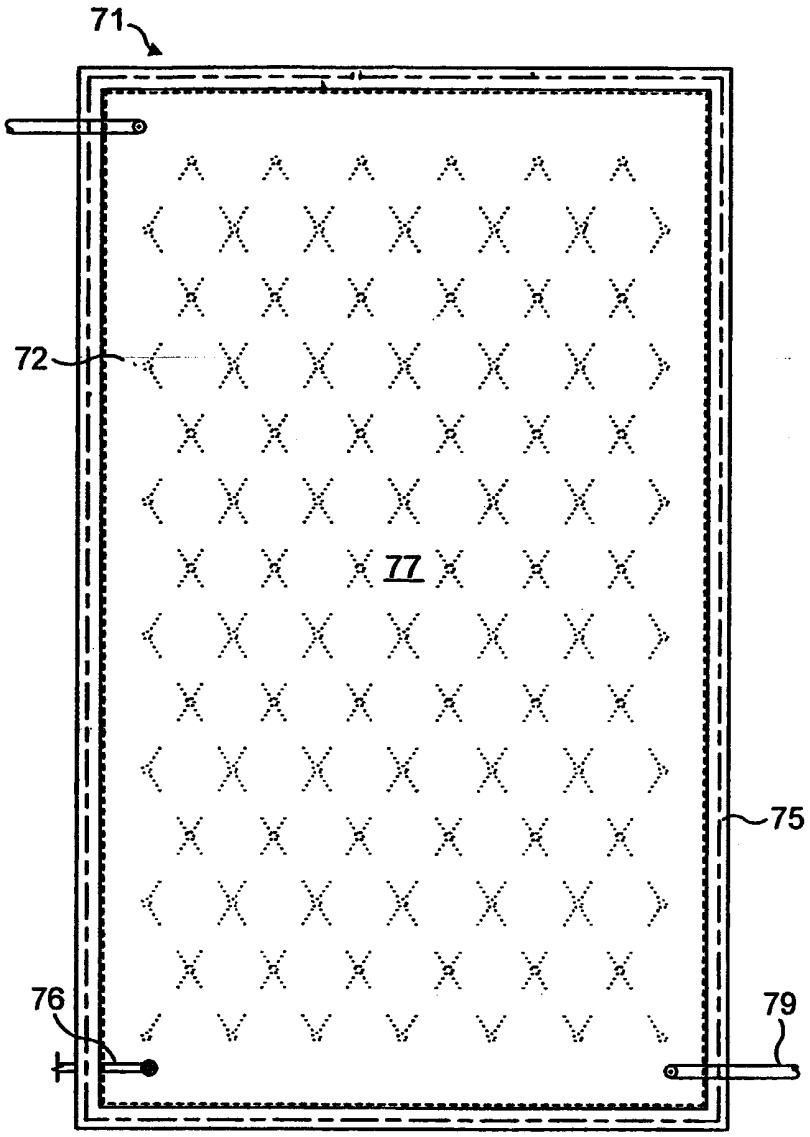

FIG. 8

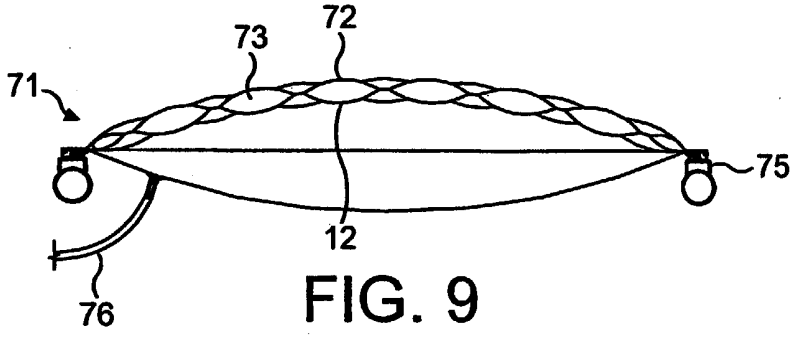

FIG. 9

BUILDING COMPONENTS

The present invention relates to building components, particularly, but not exclusively, for roofing, in the form of inflatable cushions. The cushions comprise two or more layers of a plastics foil material such as ETFE (ethylene tetra flouro ethylene) inflated with low pressure air. The ETFE foil cushion is restrained in a perimeter frame usually manufactured from extruded aluminium, which in turn is fixed to a support structure. As the ETFE foil cushion is inflated, the ETFE is put under tension and forms a tight drum like skin. ETFE foil cushions are sold under a number of trade names, for example Texlon.

ETFE cushions of this kind are fixed to a support structure to form a cladding and are used to enclose atria or other enclosed spaces to provide a transparent or translucent roof or façade to the enclosure, as an alternative to and in a similar way to glass. A number of buildings have been built using this technology most notably the Eden project in Cornwall, England.

Whenever a space is enclosed by a cladding system, due consideration needs to be given to the acoustic properties of the cladding system and how it affects the ambience of the enclosed space. ETFE foil cushions are acoustically fairly transparent having a sound reduction index of approximately 8 dBA. This is generally beneficial to the perceived acoustics of an enclosed space as the ETFE foil cushions act as acoustic absorbers to internally generated noise in that they only reflect a small proportion of the sound energy generated back into the enclosure. When it rains however the rain drums on the external surface of the inflated ETFE foil cushion and generates a loud noise, which can be obtrusive to the occupants.

It is the object of the present invention to reduce the amount of noise generated by rain falling on an ETFA foil cushion.

According to the invention there is provided a building component in the form of an inflatable cushion, comprising two or more sheets of plastics foil and a relatively rigid frame surrounding and supporting the foil sheets, and liquid retaining means associated with one of the sheets.

Preferably, the frame is manufactured from a metal, eg extruded aluminium, which in turn is fixed to a support structure. Preferably, the sheets are made from ethylene tetra flouro ethylene (ETFE).

Thus, the ETFE foil cushion is fitted with a device which reduces the effects of rain generated noise by reducing the vibration of the external layer of the inflated ETFE foil cushion by dampening it with a liquid. In addition the sound reduction index of the inflated ETFE foil cushion is increased due to the increased mass of the ETFE foil cushion due to the addition of the liquid. Preferably, two of the sheets define a space between them which is inflated with air and the frame restrains the sheets about their perimeters, thereby forming the cushion.

In one embodiment, the liquid retaining means comprises means applied to the outer most sheet of the cushion, arranged to retain rain water on the surface of the outermost sheet. The liquid retaining means may comprises a woven material, a net, or a sheet which is holed, cut, textured or embossed. Alternatively, the liquid retaining means comprises a further sheet of plastics material overlying the outermost sheet of the cushion thereby defining a fluid-tight compartment between the further sheet and the outermost sheet, the compartment being fillable with a liquid. Preferably, the further sheet is partially fixed to the outermost sheet. The fixing may be by means of welding, gluing or stitching. The sheets may be fixed together along lines, thereby defining the compartment as a continuous channel or at individual points.

There are therefore generally two ways of fitting the rain suppressor to the ETFE foil cushion. Firstly, an open weave fabric, net, holed or textured material is patterned or shaped to fit over the outer surface of the cushion. When it rains, water gathers on the surface of the cushion which reduces the effects of rain drumming by damping, and increases the sound reduction index of the cushion by the increase of mass through the addition of water. Secondly, the outer skin of the cushion is effectively made up of two layers of ETFE foil welded together in places to form a continuous pipe or chamber. Water is introduced between the layers of foil, which reduces the effects of rain drumming by damping and increases the sound reduction index of the cushion by the increase of mass through the addition of water.

The invention also extends to a cladding system for a building, particularly a roof, comprising a plurality of building components as described, the frames of which are attached to a structure.

The invention may be carried into practice in a number of ways and some embodiments will now be described by way of example with reference to the accompanying drawings.

Figure 1 is a plan view of an ETFE cushion in accordance with the present invention;

Figure 2 is a perspective cross section through the assembly of Figure 1;

Figure 3A to 3D show four different variants of covering;

Figure 4 is a view similar to Figure 1 showing an alternative embodiment;

Figure 5 is a cross section through the assembly of Figure 4;

Figure 6 is a three dimensional view of the embodiment of Figures 4 and 5;

Figure 7 is a section on the line A-A in Figure 6;

Figure 8 is a view similar to Figure 4 showing an alternative embodiment; and

Figure 9 is a cross section through the assembly of Figure 8.

Figure 1 shows an ETFE cushion in accordance with the invention. The cushion 11 comprises three rectangular ETFE foil sheets 12, 13, 14, a support frame 15 and a plenum 16. The frame 15 is located about the perimeter of the sheets 12, 13, 14 and incorporates a rain suppressor. The space between the sheets 12, 13, 14 is inflated with air via the plenum 16. Although shown as being rectangular, the cushion 11 could be of any convenient shape.

The rain suppressor 17 is in the form of an open weave material stretched over the outside surface of the cushion 11. This is shown in more detail in Figure 3A.

The variant shown in Figure 3B is a film or extruded material 27 with punched holes 28, that would be stretched over the cushion 11. The holes 28 would typically be between 0.5mm and 3mm across, though other sizes would be possible.

The variant shown in Figure 3C consists of a film or extruded material 37 with small parallel cuts 38 made in it in a diamond pattern. The material is stretched to form a netlike material and then stretched over the outside surface of the cushion 11.

The variant shown in Figure 3D consists of a film or extruded material 47, which has a textured or embossed surface and which is stretched over the outside face of the cushion 11. The function of the textured or embossed surface is to slow the passage of rain water over the surface of the cushion and clearly many textures and embossed patterns could perform this function.

The preferred material for all the variants in Figures 3A to 3D is ETFE due to its long life but clearly other films woven or extruded materials are possible.

The embodiment shown in Figures 4 to 7 consists of a frame 55 holding an ETFE foil cushion 51 which is inflated by air via a plenum 56 and which incorporates a rain suppressor 57 as is the case in the previous embodiment and its variants. In this case however, the rain suppressor 57 consists of a further sheet 52 of an extruded material which is partially fixed by welding, gluing or stitching to the uppermost ETFE sheet 12 to form a fluid tight compartment 53 between the two sheets 12,52. The fluid tight compartment 53 is filled via a hose 59 with a distilled water.

When it rains or when the cushion 51 is required to form an acoustic barrier between two areas, fluid is introduced between the two sheets 12,52 to increase the mass of the cushion 51 and to damp the surface with fluid. Any fluid can be used although ideally it should be distilled water to ensure no residue is left in the compartment 53. The fluid should be pumped although alternative methods of introducing fluid in to the rain suppressor are possible, including gravity feed, fed by rainwater.

Figures 6 and 7 show one possible way of fixing the two sheets 12,52 of material together. The fluid compartment 53 takes the form of a continuous channel 58 as the two sheets 12,52 are fixed together on the lines indicated at 61.

Figures 8 and 9 show an embodiment similar to that of Figures 4 to 7. Figure 8 shows a frame 75 holding an ETFE foil cushion 71 which is inflated by air via a plenum 76. The rain suppressor 77 again consists of a further sheet 72 of an extruded material but in this case, it is partially fixed by spot welding, gluing or stitching to the uppermost sheet 11 of the ETFE cushion

71 to form a fluid tight compartment 73 between the two layers. The fluid tight compartment 73 is filled via a hose 79 with distilled water.

CLAIMS

1. A building component in the form of an inflatable cushion, comprising two or more sheets of plastics foil and a relatively rigid frame surrounding and supporting the foil sheets, and liquid retaining means associated with one of the sheets.

2. A building component as claimed in Claim 1, in which the sheets are made from ethylene tetra fluoro ethylene (ETFE).

3. A building component as claimed in Claim 1 or Claim 2, in which two of the sheets define a space between them which is inflated with air and the frame restrains the sheets about their perimeters, thereby forming the cushion.

4. A building component as claimed in any preceding claim, in which the frame is of metal.

5. A building component as claimed in any preceding claim, in which the liquid retaining means comprises means applied to the outermost sheet of the cushion, arranged to retain rain water on the surface of the outermost sheet.

6. A building component as claimed in any preceding claim in which the liquid retaining means comprises a woven material, a net, or a sheet which is holed, cut, textured or embossed.

7. A building component as claimed in any of Claims 1 to 4, in which the liquid retaining means comprises a further sheet of plastics material overlying

the outermost sheet of the cushion thereby defining a fluid-tight compartment between the further sheet and the outermost sheet, the compartment being fillable with a liquid.

8. A building component as claimed in Claim 7, in which the further sheet is partially fixed to the outermost sheet.

9. A building component as claimed in Claim 8, in which the fixing is by means of welding, gluing or stitching.

10. A building component as claimed in Claim 8 or Claim 9, in which the sheets are fixed together along lines, thereby defining the compartment as a continuous channel.

11. A building component as claimed in Claim 8 or Claim 9, in which the sheets are fixed together at individual points.

12. An inflated ETFE foil cushion assembly constructed and arranged substantially as herein specifically described with reference to and as shown in any of Figures 1 to 9 of the accompanying drawings.

13. A cladding system for a building comprising a plurality of components as claimed in any preceding claim, the frames of which are attached to a structure.

INVESTOR IN PEOPLE

Application No: GB 0208480.4 **Examiner:** Tom Roberts
Claims searched: 1-13 **Date of search:** 30 August 2002

9

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): E1D: DCF, DF116

Int Cl (Ed.7): E04C

Other: Online: EPODOC, PAJ, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	US4807405	(BORGQUIST) See abs, figs. 1-3	1-3
X	US4773190	(ICI) See whole doc, esp. figs 3&4, para 2 page 4	1-4, 13

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.