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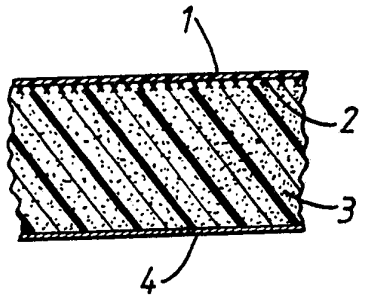

(57) Abstract

An insulation panel is formed with an upper layer (1) in the form of a weatherproof membrane which is permeable to water vapour, an intermediate foamed layer (3) and a lower metallic layer (4) which acts as a vapour barrier. The foamed layer (3) provides thermal insulation and acts as a bond between the outer layers (1 and 4). Ideally a glassfiber layer (2) will be embedded into the upper region of the panel to provide added rigidity. The edges of the panel will ideally be formed with interlocking rib and groove formations which can also be interconnected with supporting channel members for a complete roofing system.

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"Improvements relating to Insulation Panels"

This invention is concerned with various features which may be incorporated into a roofing system constructed from a number of panels which are to be laid to form a new roof surface or to be laid over an existing roof surface. The surface may be substantially horizontal as a flat roof structure, or on an incline as a pitched roof structure.

From one aspect this invention provides a novel insulation panel formed to have an upper layer in the form of a weatherproof membrane, which is permeable to water vapour, a lower metallic layer to provide strength and act as a vapour barrier, and an intermediate foamed layer which gives rigidity to the panel, provides thermal insulation and acts as a bond between the outer layers.

The preferred form of material for creating the foam comprises a cellular plastics material having a density in the range of 30 to 150 Kg per cubic meter, such as a polyurethane or polyisocyanurate material.

The membrane may be formed from an elastomeric or thermoplastic material, such as polyvinylchloride, or a thermosetting material such as polyester resin or epoxy resin, any combination of these materials or any other convenient plastics material, the material having a thickness lying in the range of 0.1 to 3 mm. Because the membrane is permeable it will allow gaseous water vapour trapped within the insulation panel to escape through the top surface, but of course the weatherproof membrane will not allow rainwater to pass through into the body of the roofing panel. Fillers could be incorporated into the upper layer or granular facing material could be bonded to the upper layer to give a

decorative effect or to enhance the ultra-violet performance of the panel.

Additional rigidity of the panel and stiffness of the upper surface may be achieved by means of a fibrous material embedded into the upper region of the panel. This material will be one which is able to transmit water vapour through its fibrous structure. The distance between the upper weatherproof membrane and the fibrous material most preferably will be less than 5mm and in the desired arrangement there will be no gap. Indeed the fibrous material embedded in a suitable resin could itself comprise the weatherproof membrane of the upper layer.

A preferred fibrous material is woven or non-woven glassfibre fabric or a combination of fabrics having a weight lying in the range of 100 to 2,000 grammes per square meter, or a woven or non-woven carbon fibre fabric or a combination of fabrics having a weight lying in the range of 50 to 1,000 grammes per square meter. This can be embedded in a polyester resin and a second woven fabric layer could be provided to form the interface between the polyester and the foam, for example polyurethane in particular.

The lower metallic layer is ideally formed from aluminium or an aluminium alloy which may have a thickness in the range of 25 to 1,000 microns. The aesthetic appearance of such an aluminium layer may be improved by forming it with shallow corrugations, or an embossed pattern.

The invention further extends to a system of fixing roofing panels onto a roof surface which comprises channel members providing for support and location of the panels, the panels having complementary rib or groove formations which will locate with the channel members.

Ideally the interconnection of the panels with the channel members will be by way of tongue and groove joints and adjacent panels may additionally be interconnected by tongue and groove joints. Alternatively, abutting edges of adjacent panels could be interlocked by inserting a connecting strip into adjacent grooves in the abutting edges of the panels.

Tongue and groove formations in the panels may be reinforced by embedding a fibrous material into the surface of the foam forming the body of the panel. This fibrous material could be a woven or non-woven glassfibre fabric having a weight in the range of 50 to 800 grammes per square meter. Preferably, however, the surfaces of the tongue and groove formations will be covered by a thin layer of aluminium or other material providing a vapour barrier.

The forms of panel of this invention as defined herein may be provided with a convex top surface so as to provide drainage and assist in dispersement of dust or debris deposit on the surface. If desired, a relief pattern could be moulded onto the upper surface of the panel. It is also possible to form each panel so that abutting edges of adjacent panels will overlap to form a weatherproof self-draining surface when the panels are laid in an inclined arrangement.

From a further aspect, this invention provides means for joining adjacent panels of the roof structure, wherein the adjacent edges of the panels are bevelled down towards the lower surface thereof so as to form a V-shaped channel between abutting edges, the gap between the edges being covered by a joining strip formed from a material which is similar in composition to or is compatible with the upper layer of the panel.

Bonding of the strip to the panels can be achieved by solvent welding, heat welding or hot melt adhesive,

but it is preferred that the centre portion of the joining strip should not be bonded to the panels so that movement of the panels is possible without excessive stretching of the joining strip. The gap below the unsecured central portion of the joining strip also allows water vapour, which migrates from below into the joint, to disperse. Ideally, the joining strip has an elongation at break of greater than 20%.

If the panels are interconnected by means of abutting tongue and groove joints, then these joints may be sealed by a compressible sealing strip which would impede the passage of water vapour through the joint.

The invention may be performed in various ways and preferred embodiments thereof will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a vertical section through a portion of a roofing panel constructed in accordance with this invention;

Figure 2 shows a roof area covered with roofing panels of this invention;

Figure 3 illustrates a means of interconnecting two roofing panels in accordance with the invention; and

Figure 4 shows a method of overlapping roofing panels.

The preferred form of roofing panel shown in Figure 1 comprises three main layers, namely an upper layer formed by a vapour permeable weatherproof membrane 1 with a layer of woven glassfibre 2 immediately therebelow, a lower layer formed from aluminium sheet 4 and an intermediate layer formed from a body of polyurethane foamed material 3. The layer 1 can be formed from a form of polyvinyl chloride (PVC). The foam layer 3 provides insulation, bonds the various materials together, and, in conjunction with the aluminium sheet 4 and the woven glassfibre 2, forms a

beam of sufficient stiffness to resist the downward and upward loads to which a roof is normally subjected. In the preferred construction layer 2 will be formed from a polyester material in which one layer of glassibre is embedded, with a further fibreglass layer being laid over the polyester at the interface with the polyurethane foamed material 3. The polyester and polyurethane layers can then bond to either side of the further glassfibre layer.

Panels constructed in accordance with the method shown in Figure 1, or indeed panels constructed in other forms, may be interconnected by the method as shown in Figure 2. Here a supporting array of steel channels 6 is laid over an existing roof or roof structure 7 and is secured in place. The array of steel channels are fixed together with fall adjustment spacers 8 to convert a flat roof to an inclined roof surface, but can be laid in a substantially horizontal plane to form a flat roof or on an inclined plane to form a pitched roof. Two sides of each panel 9 have open mouthed formations 10 which define ribs 11 (Figure 3). One rib 11 will be introduced into the channel member 6. The remaining portion of the mouth 10 can then receive a rib 12 formed at one of the other two edges of another panel 13. By this means the various panels may be securely fixed to the array of channel members 6. The positioning of the mouth 10 will be such that the channel member 6 will not extend up into the panel by more than 50% of the panel depth so as to avoid cold bridging. The ends of the panels may also be interconnected with one another by the rib and groove formations 12 and 10, the end groove 10 being equivalent in size to the end rib 12, so that they fit tightly onto one another.

It will be noted that the upper surfaces of the panels 9 and 13 as they approach the edges are chamfered

at 14 so that when they are abutting a shallow groove is formed. A joining strip 15 is bonded to the faces 14, but only at the edges, leaving the central portion of the joining strip 15 unbonded so that it is free to flex should movement of the panels occur (for example due to changes in temperature). Positioning the strip 15 in the V-shaped channel provides protection against damage due to persons walking over the panel. The strip 15 is formed from an elastomeric material. It will be noted that the upper surface of the panels may be flat as shown on panel 9 or convex as shown on panel 13. In either case water drains from the panel surface into the channel covered by the strip 15. The convex surface on panel 13 enhances the drainage from the panel surface.

As can be seen further from Figure 3, the lower aluminium layer 4 is augmented by formed aluminium edging strips 16 fixed around the surfaces of the rib 12 and groove 10 formations so as to provide a secure vapour barrier to the base and sides of the panel system

Where the roof panels are to be mounted on a sloping roof surface the lower edges of the panels 17 can be formed with an undercut 18 which will receive the upper edge of an adjacent panel 19 as shown in Figure 4. This joint also allows interlinking with steel channels 6 of the form shown in Figure 2.

CLAIMS

1. An insulation panel characterised by an upper layer (1) in the form of a weatherproof membrane which is permeable to water vapour, and preferably formed from an elastomeric or thermoplastic material, such as polyvinylchloride, a thermosetting material, such as polyester resin or epoxy resin, any combination of these materials, or any other convenient plastics material having a thickness lying in the range of 0.1 to 3 mm, and possibly incorporating fillers in the upper layer or granular facing material bonded to the upper layer to give a decorative effect , or to enhance the ultra violet performance of the panel, and/or possibly having a relief pattern moulded into the upper surface, a lower metallic layer (4), preferably extending up the sides of the panel, and providing strength and acting as a vapour barrier, and ideally being formed from aluminium or an aluminium alloy having a thickness in the range of 25 to 1,000 microns, and possibly being formed with shallow corrugations or an embossed pattern, and an intermediate foamed layer (3), preferably formed from polyurethane or polyisocyanurate material, or other cellular plastics material having a density in the range of 30 to 150 Kg per cubic meter, which gives rigidity to the panel, provides thermal insulation and acts as a bond between the outer layers.

2. A panel according to claim 1, further characterised by having a fibrous material (2) embedded into the upper region of the panel, the fibrous material being one which is able to transmit water vapour through its fibrous structure, the distance between the upper weatherproof membrane and the fibrous material preferably lying between 0 and 5 mm, and possibly the fibrous material, wholly or partially embedded in a

suitable resin, comprising the weatherproof membrane of the upper layer.

3. A panel according to claim 2, further characterised in that the fibrous material is woven or non-woven glassfibre fabric or a combination of fabrics having a weight lying in the range of 100 to 2,000 grammes per square meter, or a woven or non-woven carbon fibre fabric or a combination of fabrics having a weight lying in the range of 50 to 1,000 grammes per square meter, and preferably embedded in a polyester resin, with a second woven fabric layer ideally being provided to form the interface between the polyester and the foam layer, such as of polyurethane.

4. A system for fixing roofing panels onto a roof surface which comprises channel members (6) providing for support and location of the panels, characterised in that the panels have complementary rib or groove formations (12, 10) which will locate with the channel members, such as by way of tongue and groove joints, adjacent panels ideally additionally being interconnected by tongue and grooved joints, or being interlocked by inserting a connecting strip into adjacent grooves in the abutting edges of the panels.

5. A system according to claim 4 further characterised in that tongue and groove formations in the panels are reinforced by embedding a fibrous material into the surface of the foam forming the body of the panel, such fibrous material preferably being a woven or non-woven glassfibre fabric having a weight in the range of 50 to 800 grammes per square meter, or wherein the surfaces of the tongue and groove formations are covered by a thin layer (16) of aluminium or other material providing a vapour barrier.

6. A system according to claim 4 or claim 5, further characterised in that the panels (9, 13) are

provided with convex top surfaces, and/or each panel is formed so that abutting edges of adjacent panels (17, 19) will overlap to form a weatherproof self-draining surface when the panels are laid in an inclined arrangement.

7. Means for joining adjacent panels of a roof structure, characterised in that the adjacent edges (14) of the panels are bevelled down towards the lower surface thereof so as to form a V-shaped channel between abutting edges, the gap between the edges being covered by a joining strip (15) formed from an elastomeric material, bonding of the strip to the panels preferably being achieved by solvent welding, heat welding or hot melt adhesive, the panels desirably being interconnected by means of abutting tongue and groove joints, with these joints being sealed by a compressible sealing strip which will impede the passage of water vapour through the joint.

8. Panel joining means according to claim 7, further characterised in that the centre portion of the joining strip is not bonded to the panels so that movement of the panel is possible without excessive stretching of the joining strip, and preferably the joining strip has an elongation at break of greater than 20%.

9. A roofing panel substantially as herein described with reference to the accompanying drawings.

10. A system of fixing roofing panels onto a roof surface or means for joining panels and substantially as herein described with reference to the accompanying drawings.

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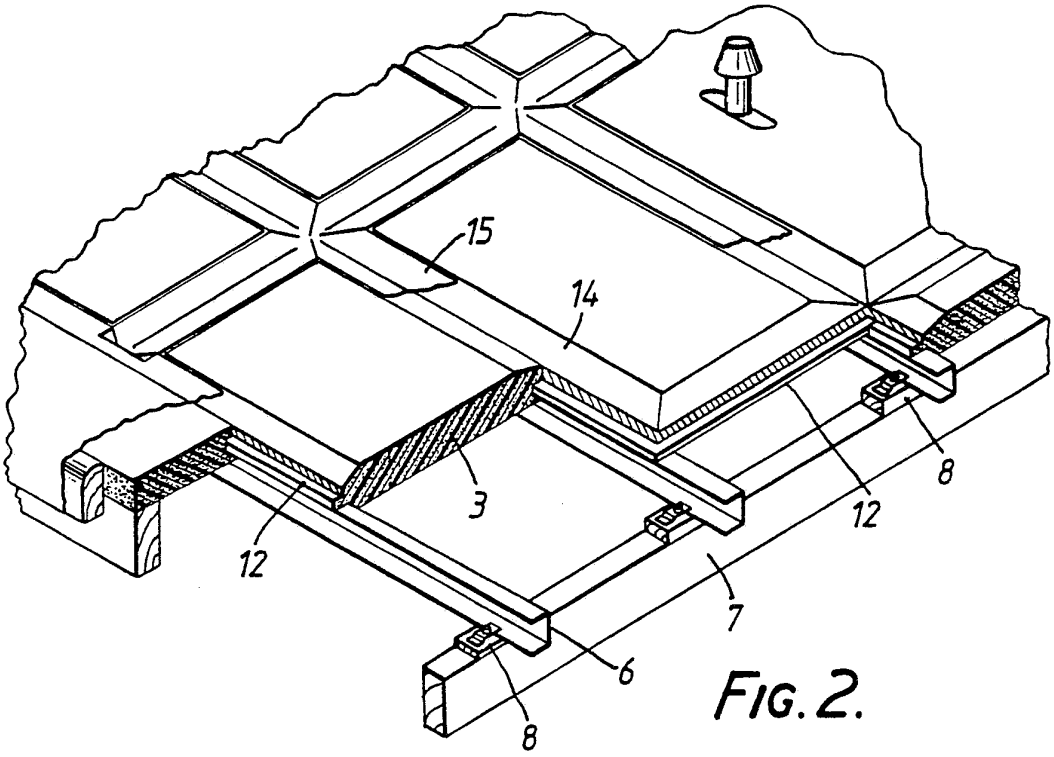

FIG. 2.

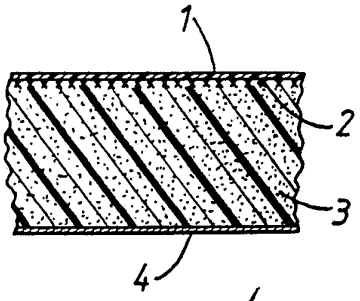

FIG. 1.

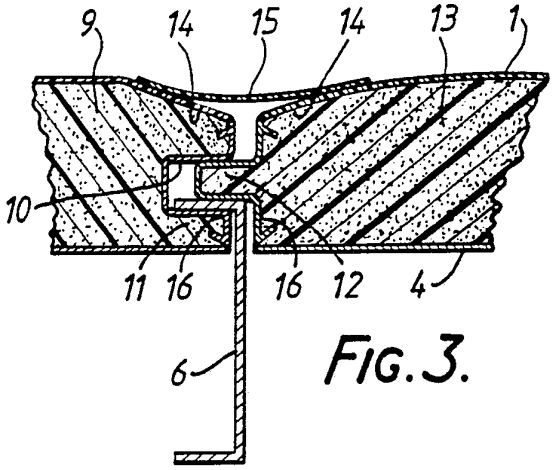

FIG. 3.

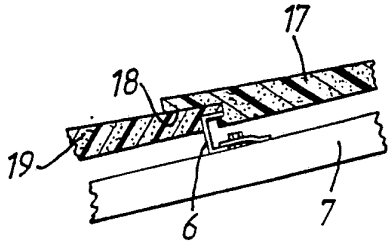

FIG. 4.