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(71) Applicant: **Wright, John Houldsworth**
31 Colesbourne Road
Benhall Cheltenham Gloucestershire(GB)

(72) Inventor: **Wright, John Houldsworth**
31 Colesbourne Road
Benhall Cheltenham Gloucestershire(GB)

(74) Representative: **Dunlop, Brian Kenneth Charles et al,**
c/o Wynne-Jones, Lainé & James 22 Rodney Road
Cheltenham Gloucester GL50 1JJ(GB)

(54) **Improvements relating to roofing treatment.**

(57) A roofing tile is provided for both insulating and weatherproofing an existing roof surface. The tile 1 has a flat top surface defined by a layer 2 of a high density plastics material whilst the remainder of the tile is formed from a lower density rigid polyurethane foamed material. Passageways 7 from the top surface lead to cavities 4 defined below the tile between radially extending ribs 5. A polyurethane foam is injected through the passageways 7 to fill the cavities 4 until excess foamed material passes out through side passageways 8 into depressions 10. A foam provides the required insulation and also helps to secure the tile to a roof surface. The top layer 2 is formed from a weatherproof material or has a waterproof membrane applied to it. The contact adhesive strip 11 enables the tile to be fixed to an existing surface.

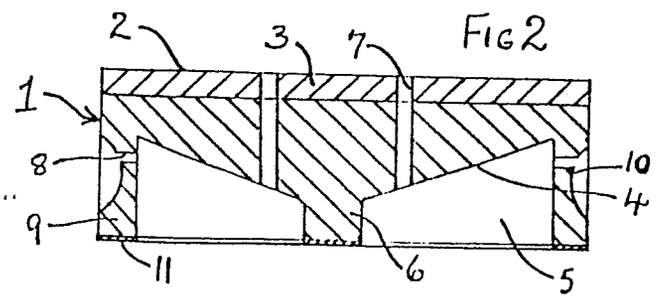

FIG 2

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"Improvements relating to Roofing Treatment"

This invention is concerned with methods of protecting and insulating existing roofs.

It is known that an existing external roof surface can be given a protective coating by applying a flexible reinforcing sheet and brushing a membrane liquid onto that sheet. When the liquid has set it provides a very effective water resistant surface. Roof insulation is conventionally achieved by lining the under-surface of a roof or the floor of a roof space with any one of a number of proprietary insulating materials.

It is an object of this invention to provide means whereby weatherproofing and heat insulation may be applied to a roof surface at one and the same time.

Accordingly this invention provides a roofing tile formed from a plastics material having a high density top surface and defining an underneath cavity, the cavity region incorporating strengthening and support members and communicating with the exterior of the tile through passageways in the top and side walls.

Such tiles may be laid over an existing roof surface and then a foam-setting insulating material can be injected through the passageways in the top walls of the tiles, this has the effect of bonding and sealing the tiles to the roof surface, and the

foam-setting material acts as a heat insulator as well as providing weatherproofing, at least to some extent. Ideally the top surface of the tile will be pre-coated with a waterproofing membrane to create a greater degree of weatherproofing.

In the preferred arrangement the strengthening and support members will be ribs dividing the cavity into separate regions. These ribs could extend from the centre to the four corners of a square or oblong tile to define four essentially triangular separate cavity regions. The support members will then preferably include a central boss extending down to the base level of the tile. Greater support can be achieved by a larger number of radiating ribs, which need not necessarily be linked to the side walls on a central boss.

If the side walls of the tile surrounding the cavity are so dimensioned and constructed as to be capable of being compressed partially when pressed by a heavy roller, then an array of tiles can be rolled so as to create a fairly even overall top surface.

It is preferred that the through passageways in the side walls should terminate in cavities formed in the outer surface of the side walls. Excess injected foam-setting material can then pass into these cavities to ensure the sealing of any gaps between adjacent tiles

and bonding together of adjacent tiles.

The cavity (or separate regions thereof) of the tile is ideally defined by a top wall surface which internally slopes upwardly from the centre to the edges of the tile. Injected foam-setting material will then tend to expand upwardly and outwardly to ensure spread of the foam-setting material within the cavity.

The high density top surface of the tile may be a separate sheet bonded to the remainder of the tile formed from a lower density plastics material, or the two parts could be formed in separate stages of a forming operation from plastics materials. In any event part or all of the tile may be formed from a foamed plastics material.

The tile top surface may with advantage incorporate a decorative pattern or shaping to represent a conventional roofing tile member. The base of the tile can, if necessary, be shaped to fit a corrugated or other non-planar existing roof surface. The tiles will naturally need to be fixed in place on the existing roof surface and rather than achieving this by applying an adhesive to the existing roof surface it may be preferable to provide the under-surfaces of the side walls of the tile with a contact adhesive which can, for example, be covered by a removable backing strip.

The invention also extends to a method of covering

an existing roof surface which comprises laying roofing tiles of this invention of the form as defined above in an abutting side-by-side relationship and injecting a foam-setting plastics material through the passageways in the top walls of the tiles to fill the underneath cavities.

The foamed material is ideally a polyurethane foam. Ideally the foamed material will be injected by an injection gun set to inject a predetermined quantity sufficient to fill the underneath cavity or separate cavity region of one tile. The passageways through the top walls of the tiles can be plugged with portions of dowelling formed from polyurethane or other convenient plastics material after injection of the foamed material.

Special tiles may be formed having a predetermined shallow pitch on the top surface from one side to the other. A series of tiles of this type having varying thicknesses may be laid side-by-side to define a pitch to the roof surface eventually formed by the laid tiles. If necessary a special central tile forming a ridge on its top surface may be used to form a new roof surface having a pitch face sloping down on both sides from the special ridged tile.

In an alternative arrangement spacer tiles may be provided for fixing to a roof surface prior to

the application of a standard roof tile, some at least of the spacer tiles being formed with a predetermined shallow pitch on the top surface from one side to the other. Additional spacer tiles of constant thickness could be used in association with the pitched spacer tiles to achieve a build-up in height as one progresses from one side of a proposed slope to the other. It is envisaged that the spacer tiles of constant or pitched shape should have no enclosing top wall so that cavities will pass directly through from the top to the bottom of the spacer tiles so as to communicate with the enclosed cavities on the under-surfaces of the standard tiles which will be laid on top of the spacer tiles.

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 an underneath plan view of a roofing tile of this invention;

Figure 2 is a vertical cross-section through the centre of the tile shown in Figure 1;

Figure 3 is a side view of an array of tiles fixed to an existing roof surface;

Figure 4 is an underneath plan view of an alternative design of roofing tile of this invention;

Figure 5 is a vertical cross-section through the centre of the roofing tile shown in Figure 4;

Figure 6 illustrates a modified form of roofing tile for a corrugated roof;

Figure 7 is a side view of a pitched roof structure constructed in accordance with the invention;

Figures 8 and 9 are underneath plan and vertical sections through a preferred form of standard tile forming the top surface of the roof structure of Figure 7; and

Figures 10 and 11 are plan and side views of a pitched tile used in constructing the sloping roof structure illustrated in Figure 7.

The tile 1 shown in Figures 1 to 3 has a high density top layer defining a flat top surface 2,

the remainer of the tile being formed from a lower density rigid polyurethane foamed material. Four separate cavity regions 4 are defined at the under-surface of the tile by ribs 5 extending to the corners from a central boss 6. Each of the cavity regions 4 communicates with the top surface of the tile by passageways 7 and also further passageways 8 lead from the cavity regions 4 through the side walls 9. The passageways 8 terminate in cavities 10 formed into the side wall surfaces. At the base of the side walls 9 there is formed a contact adhesive strip 11 covered by a removable backing strip which can be taken off on site.

When the tiles are to be used to cover an existing roof surface the backing strips are removed to expose the contact adhesive and the tiles are then set out over the roof surface in an abutting side-by-side relationship. Any remaining gaps may be filled with half or quarter tiles as required. The tiles could have fracture lines to aid in breaking down into such smaller parts. If necessary the array of tiles may be subjected to the action of a heavy roller so as to create a particular roof fall and/or a generally even surface as the side walls 9 will tend to reduce in height partially where parts of tiles stand proud of the rest.

A polyurethane foam is then injected into each of the regions 4 through the passageways 7 and excess foamed material will pass out through the passageways 8 and into the cavities 10 so as to bond adjacent tiles to one another. Excess foam projecting above the surface of the tiles, as at 12 in Figure 3, can be cut off when the foam has set. After foam injection the passageways 7 can be plugged with portions of dowelling formed from polyurethane material. The tiles will have been pre-coated with a waterproofing membrane as part of the original tile manufacture so that the final roof surface will be water resistant. Thus the rigid layer 3 could be of polyvinylchloride providing the waterproofing effect as well as acting as the high density layer. This membrane could, if necessary, extend beyond the edges of the tile so that an overlap could be formed onto adjacent tiles. The spaces between adjacent tiles can be brushed over with a water resistant coating, have an adhesive waterproof strip applied, or be sealed by heat sealing of a compatible waterproof strip, as the final stage of forming the weatherproofed and heat insulating surface of the roof.

The modified roof tile shown in Figure 4 incorporates a preferred ribbing construction which gives better overall support for the tile surface.

Thus eight ribs 5A radiate out from an open central area which communicates with the exterior through a central single passageway 7. The central boss is omitted.

From the cross-sectional view of Figure 5 it will be seen the lower portion 9A of the side walls 9 differs from the remainder of the tile, and is formed from a compressible foamed layer of material. This allows the tile to adjust more readily to uneven surfaces (for example a roof surface provided with chippings) in that the layer 9A will compress where localised projections occur. This could be instead of or in addition to the adhesive layer 11 shown in Figure 2.

A modified method of filling the cavities within the tiles utilises an open cell flexible polyurethane foam. When set this foam will be porous and so any internal pressure which might build up due to vaporisation of trapped moisture, for example, can be relieved through the plug of foam in the passageway 7. Thus Figure 5 shows a vent cap 21 positioned over the passageway 7. Passageways 7 in other tiles could be blocked by an impervious member, such as a plug. Then if the layer 9A is also of a porous nature, relief of pressure which might build up under adjacent tiles can be relieved through the nearest tile carrying

a vent cap 21.

A flexible under layer for the tiles, by incorporating a flexible wall layer 9A and injecting a flexible foam, can achieve a number of desirable effects. Thus surface pressure on the top wall of the tile is reduced (since the lower layer is compressible), and overfill with the foam is less critical. Also a flexible layer allows for minor roof movements (due to settlement or heat expansion) and a porous layer allows for ventilation.

The top layer 3 of the tile may be a moulded sheet of polyvinylchloride, which therefore acts as the waterproofing membrane. Gaps between adjacent tiles can then readily be covered by strips of polyvinylchloride heat sealed to the tiles.

The roofing tiles can be formed with a modified underneath surface, such as that illustrated in Figure 6, where the tile is to be applied to an existing corrugated roof. Other roof shapes may be accommodated in a similar manner by suitably shaped tiles. If there should be a need or desire to apply the tiles to a roof surface with spaces between the tiles, the tiles could be pre-formed with spacer projections as necessary.

It will be appreciated that the tiles may readily be applied to the wall surfaces of buildings in a

manner similar to that described above. In this case the tile profile may be pre-formed with any desired wall texture or contoured effect.

An insulating and weatherproofed pitched roof structure as applied to an existing flat roof surface 12 is illustrated in Figure 7. This uses pitched tiles 13, spacer tiles 14 and 15 and cover tiles 16. The cover tiles are of generally standard form and thus (as shown in Figures 8 and 9) incorporate a flat top surface 2, cavity regions 4 defined by ribs 5 extending to a central boss 6 and passageways 8 through the side walls 9. In this particular embodiment it will be noted that there are three passageways 8 in each of the side walls and two passageways 8 in each of the end walls. It will also be noted that the walls 9 are slightly angled to assist the flow of foam injected into the cavities 4 on the under-surface of the tile 16.

In this example a single passageway 17 is formed at one corner only of each tile 16 passing through one of the ribs 5. A moulded tubing member 18 passes from the passageway 17 to a junction piece 19 within the central boss 6 having outlets leading into the cornersof each of the four cavities 4. When four of these tiles 16 are positioned on a roof surface so that the corners incorporating the passageways 17 are adjacent to one another it is possible to inject polyurethane

foam into the cavities of four tiles 16 simultaneously from a gun having four outlets plugged into each of the four passageways 17.

The pitched tiles 13 (as illustrated in Figures 7, 10 and 11) have sides of 1,000mm in length and a maximum height at one end of 35mm sloping down in one direction to a height of 10mm at the other end. It will be appreciated that the relative dimensions in Figure 7 have been distorted to illustrate the intended effect whilst the true shape is more realistically illustrated in the cross-sectional view shown in Figure 11. The pitched tiles 13 are also formed with ribs 5 radiating from a central boss 6 but there is no top wall so that openings 20 are formed which pass completely through the tile 13 which will therefore receive the foamed polyurethane injected into the main tiles 16, in a direct manner. This applies also to the spacer tiles 14 and 15 which, in plan view, are identical in appearance to the pitched tiles 13 as shown in Figure 10 and have the same openings 20 passing all the way through.

The spacer tiles 14 are 25mm in height whilst the spacer tiles 15 are 50mm in height. These dimensions, together with those of the pitched tiles 13 enable the height to be increased progressively as the height of the slope increases as illustrated in Figure 7.

In Figure 7 it will be noted also that a special

ridge tile 16A is provided which has a slightly longer top surface so as to define an end wall which will be co-extensive with the end walls of the pitched tiles 13 and spacer tiles 14, 15 defining the maximum height of the pitch. A similar pitched roof structure could extend downwardly from the top point so as to define a double pitched roof structure. In this instance, if desired, the special tile 16A could be replaced by a tile defining a ridge with angled surfaces leading down to both sides.

The tiles used in constructing a covering for an existing roof may be modified in other ways. Thus, for example, tiles could be shaped to receive roof vents, double glazed lights and moulded parapet walls enabling safety rails to be mounted to aid future roof access.

CLAIMS

1. A roofing tile formed from a plastics material having a high density top surface (2) and defining an underneath cavity (4), the cavity region incorporating strengthening and support members (5,6) and communicating with the exterior of the tile through passageways (7,8) in the top and side walls.

2. A roofing tile according to claim 1, wherein the strengthening and support members are ribs (5) dividing the cavity into separate regions, which ribs preferably extend from at or near the centre to the sides and/or four corners of a square or oblong tile to define essentially triangular cavity regions (4), the support members optionally also including a central boss (6) extending down to the base level of the tile.

3. A roofing tile according to claim 1 or claim 2, wherein the through passageways (8) in the side walls terminate in depressions (10) formed in the outer surface of the side walls (9).

4. A roofing tile according to any one of claims 1 to 3, wherein the cavity (4) is defined by a top wall surface which internally slopes upwardly from the centre to the edges of the tile.

5. A roofing tile according to any one of claims 1 to 4, wherein the high density top surface of the tile is a separate sheet (2) bonded to the

remainder of the tile (1) which is formed from a lower density plastics material, with part or all of the tile ideally being formed from a foamed plastics material, and preferably the side walls (9) of the tile surrounding the cavity (4) are so dimensioned and constructed as to be capable of being compressed partially when pressed by a heavy roller, such as by providing that a horizontal layer (9A) of the side walls of the tile is formed from a readily compressible foamed material.

6. A roofing tile according to any one of claims 1 to 5, wherein the tile top surface incorporates a decorative pattern or shaping to represent a conventional roofing tile member, and/or the base of the tile is shaped to fit a corrugated or other non-planar existing roof surface, and preferably the underneath surfaces of the side walls of the tile carry a contact adhesive (11).

7. A roofing tile according to any one of claims 1 to 6, wherein the top surface of the tile is pre-coated with a waterproofing membrane.

8. A roofing assembly comprising roofing tiles (16) of the form as defined in any one of claims 1 to 7, and support tiles (13,14,15) of the same shape in plan view to the roofing tiles, at least some of the support tiles (13) having side walls which taper from one side to the other, the support tiles ideally being

open at the top and bottom faces.

9. A method of covering an existing roof surface comprising laying tiles of the form as defined in any one of claims 1 to 8 in an abutting side-by-side relationship and injecting a foam-setting plastics material, such as polyurethane foam, through the passageways (7) in the top walls of the tiles to fill the underneath cavity (4), the foamed material preferably being injected by an injection gun set to inject a predetermined quantity sufficient to fill the underneath cavity or a separate cavity region of one tile, and spaces between the top surfaces of adjacent tiles are ideally covered by a waterproofing membrane as a final step.

10. A method according to claim 9, wherein the foamed material is an open cell foam which will produce a porous flexible filling for the tile, at least some of the passageways through the top walls of the tiles preferably being covered by a vent cap (21), and/or wherein passageways through the top walls of the tiles are plugged with portions of dowelling formed from polyurethane or other convenient non-porous plastics material after injection of the foamed material.

FIG 1

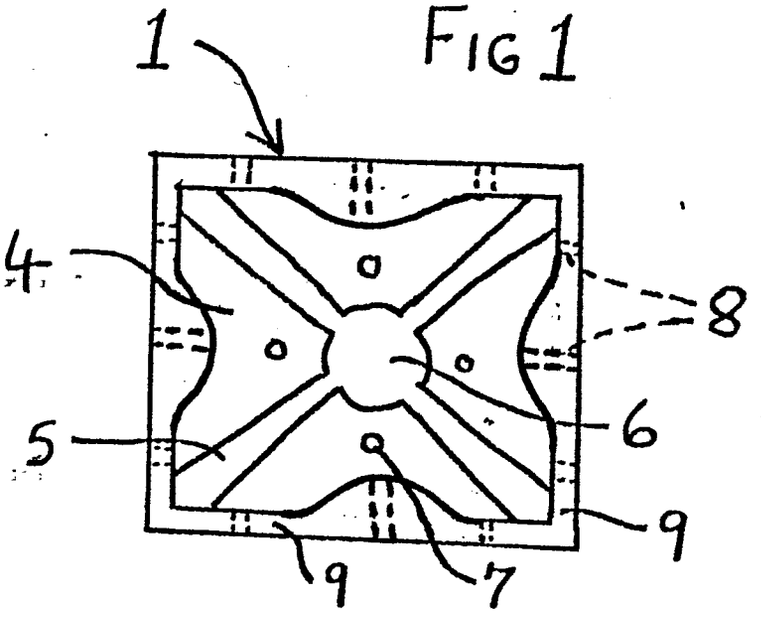

FIG 2

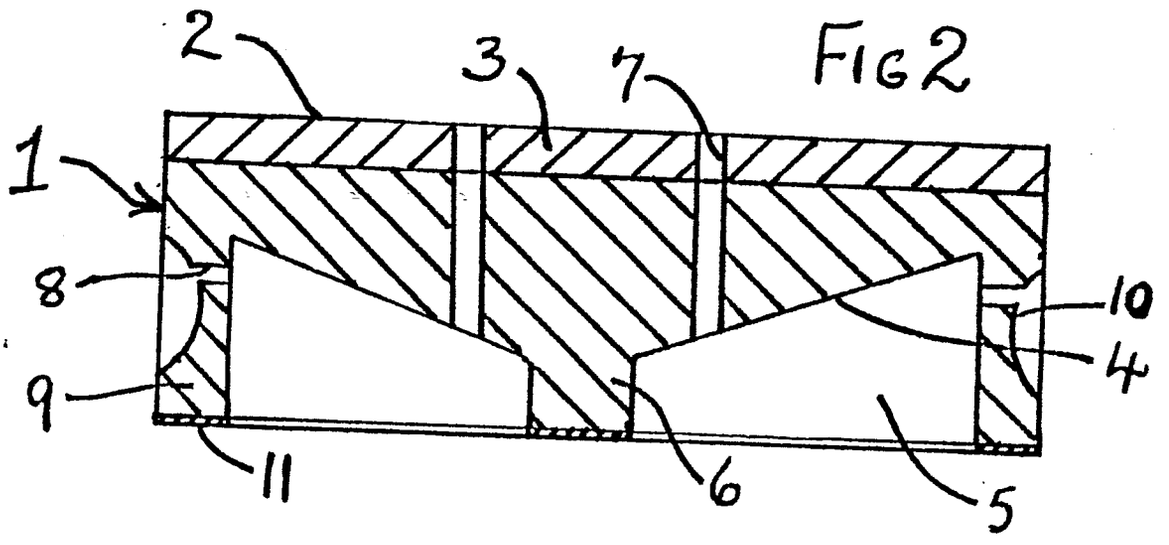

FIG.3

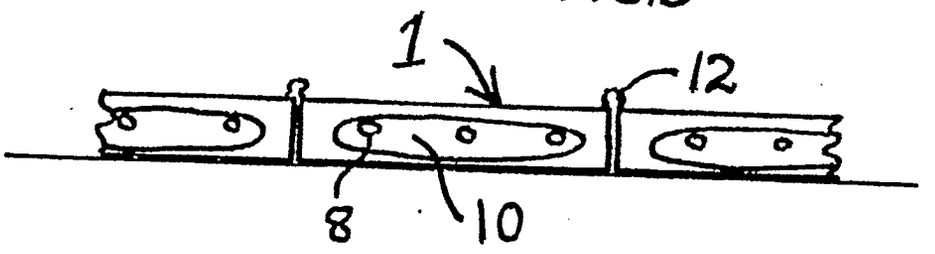

FIG. 4

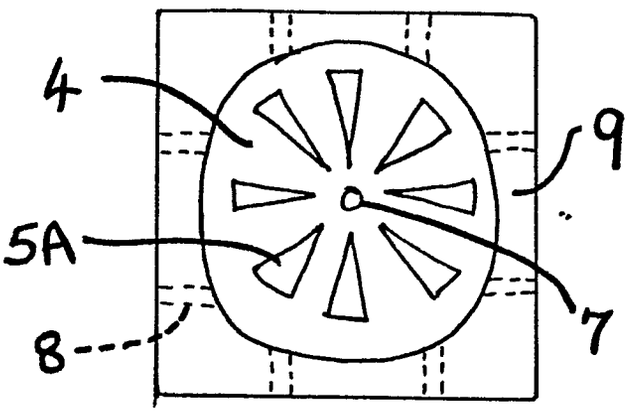

FIG. 5

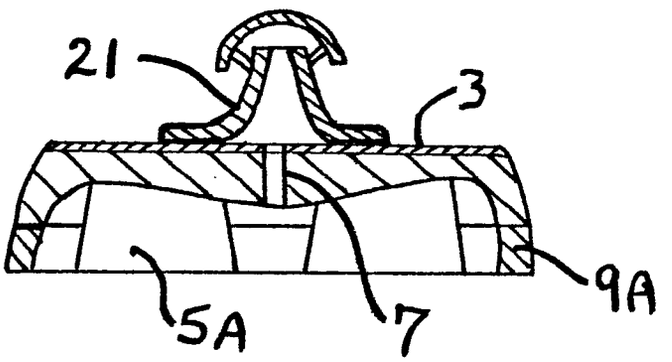

FIG. 6

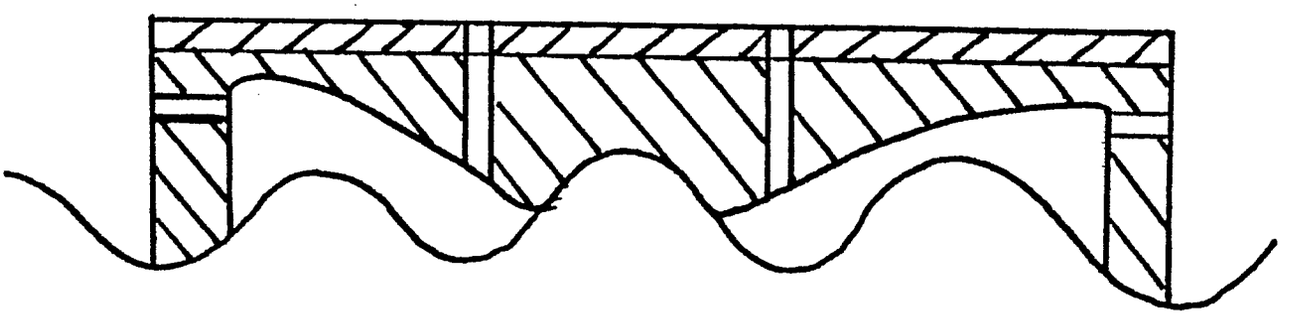

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FIG 7

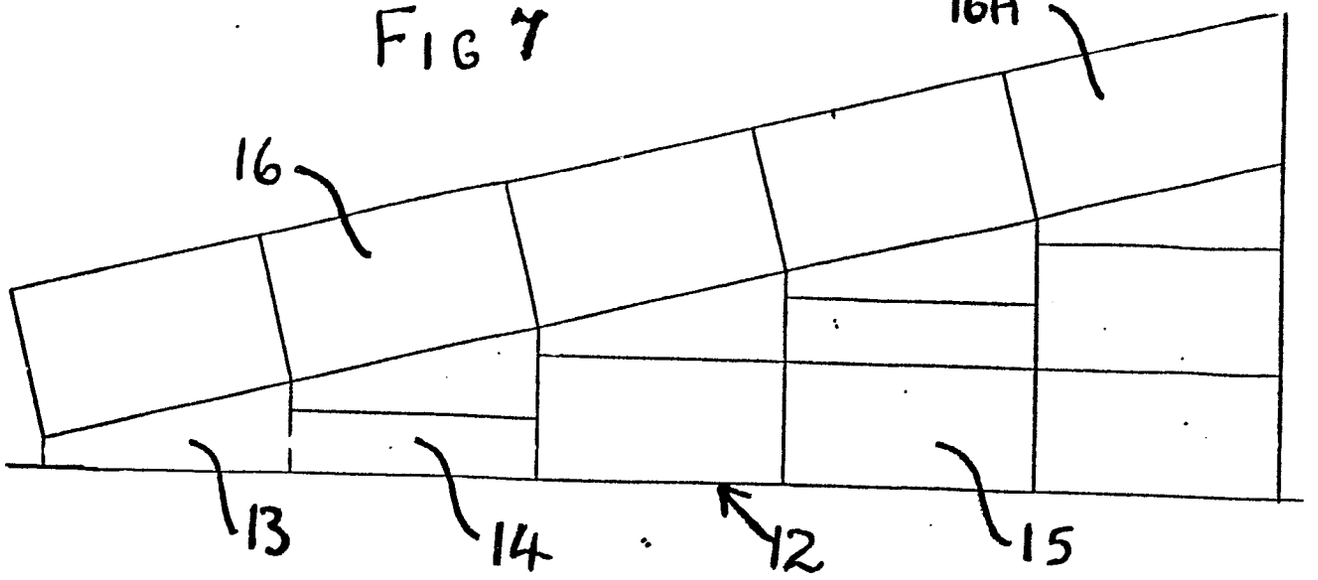

FIG.8

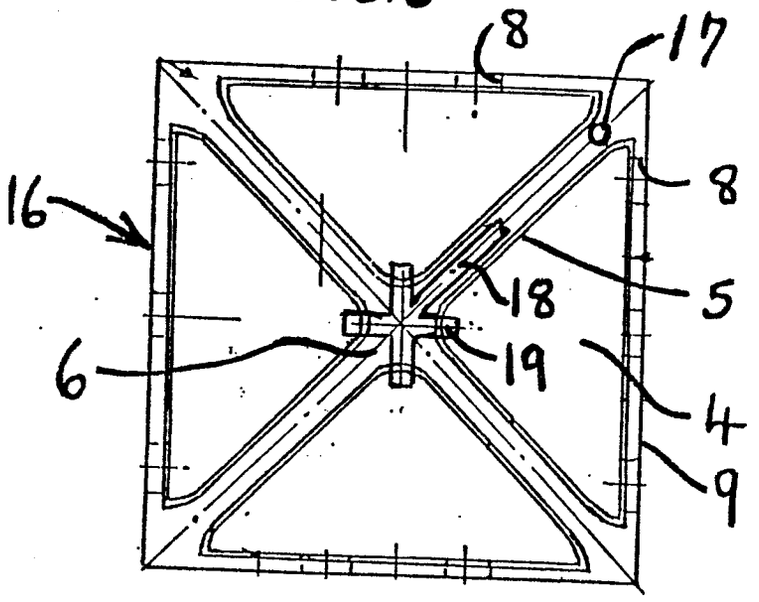

FIG.9

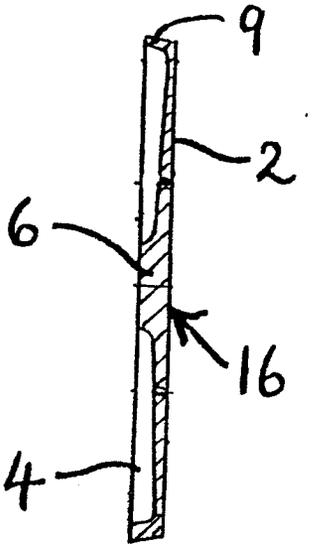

FIG.10

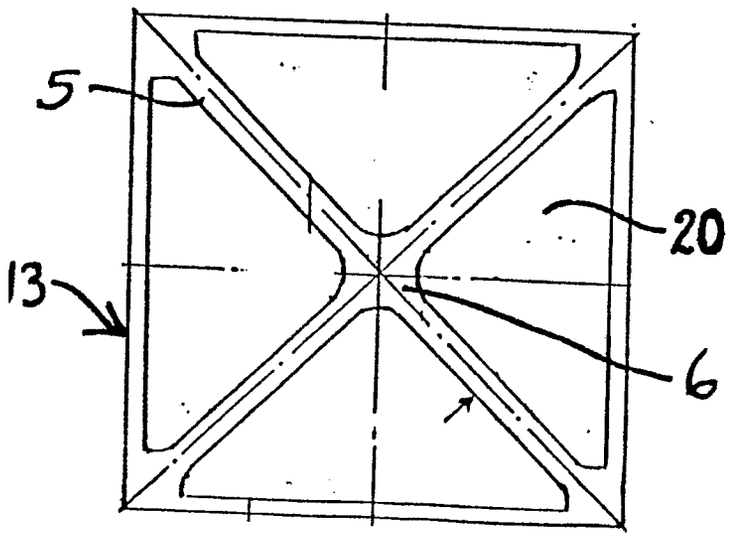

FIG.11