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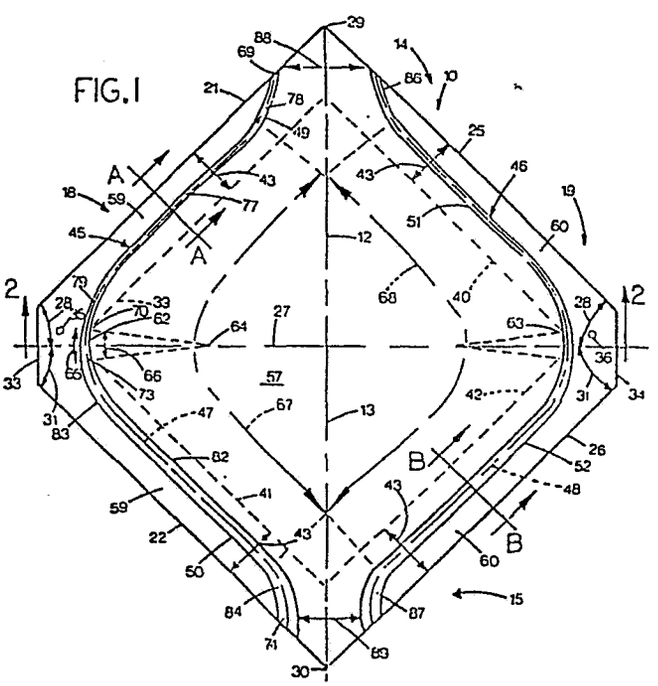
(54) **Roof tile.**

(57) A tile (10,120) is formed from a relatively thin sheet adapted to cooperate with similar tiles to form a tiled surface. When the tile is installed, the central axis (12,125) thereof coincides with a line defining free water flow down the tile between upper and lower tile portions (14,15). The tile has first and second raised ribs (45,46; 131,132) extending symmetrically as mirror images of each other on each side of central axis. Each rib has upper (49,51) and lower rib (50,52) portions which are interconnected so as to extend continuously between the upper and lower tile portions to increase stiffness of the tile. The stiffened tile is better able to resist weight of a person walking on the roof, and also resists a tendency for the lower portion of the tile to lift when wind blows onto the roof. The upper rib portions (49,51) are generally complementary to the lower rib portions (50,52) so that the lower rib portions of an upper tile can fit over upper rib portions of a lower tile. Thus rib axes (47,48) of upper and lower rib portions are also mirror images of each other about a lateral axis (27,127) disposed perpendicularly to the longitudinal axis (12,125). When the tiles fitted, the ribs of the tiles are interlocked and this increases accuracy of installation of the tiles, as well as reducing a tendency of water seepage past edges of the tiles. The tiles exhibit a high degree of fitting tolerance, even when fitted on an uneven roof, thus permitting use of relatively unskilled labour.

FIG.1



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BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a tile particularly for installation on a sloping roof, but the tile could have applications elsewhere, for example on a vertical wall.

Prior Art

Conventional interlocking roof tiles or shingles have been known for many years, and are commonly found as two main types, namely relatively thick clay tiles, or sheet tiles, which are made from sheet metal or other similar thin material. The clay tiles are heavy, mechanically relatively weak and are limited in mechanical complexity due to manufacturing difficulties and material limitations. Metallic sheet tiles also have problems, for example a tendency to bend and be permanently deformed after a person has walked over the roof, which is aggravated by insufficient backing support for the tile. Also, if a relatively thin material is used, the tile might lack adequate stiffness to resist bending under strong wind forces blowing up the roof and bending the tile upwardly, thus permitting water to penetrate under the tile. While attempts have been made to stiffen relatively thin tiles using several raised ribs extending between edges of the tile, commonly the ribs increase difficulty of installation of the tile because some designs of tile do not permit much variation or tolerance to the "fit" between overlapping portions of adjacent tiles, particularly when installed on uneven roofs. Commonly, with prior art ribbed metallic tiles, fitting errors during installation of a series of tiles can accumulate to such an extent that

unsightly gaps can exist between overlapping portions of adjacent tiles, which can permit entry of water into the roof. In general the more complex the ribbed structure of the overlapping portions, the greater the difficulty and cost of manufacture and installation.

Typical metallic tiles are shown in U.S. Patents 279,487 issued to Jones; 294,256 issued to Montross et al; 361,031 issued to Thorn; 397,298 issued to Lee, and 2,202,830 issued to Bussey. These patents disclose metallic roofing tiles with ribs to cooperate with adjacent tiles, and partially to stiffen the tile. However, some of the immediate edge fitting structure includes the actual ribs themselves, and these are quite complex and would likely present difficulties when installing the tiles. Ribs provided immediately adjacent edges of the tiles without flat side margins extending to the edges can present difficulties during the manufacture and installation.

In general, to produce a tile of a given size, tiles with several ribs or corrugations require considerably more sheet stock or raw sheet material than a flat, unribbed tile or a tile with fewer ribs. Also, some tiles require a relatively wide overlap with adjacent tiles to obtain a water tight joint, and this affects the number of tiles required to cover a specific roof area with tiles of a given size. Clearly the greater the overlap between tiles, the more tiles are required to cover a given roof area. Some prior art tiles have many corrugations and also require a large overlap and thus the effectiveness of such tiles for covering area is low.

Some of the prior art tiles have interfitting edge portions which cooperate closely with complementary edge portions of adjacent tiles such that relatively small gaps of short lengths exist between the tiles. There gaps can be of such a size as to cause water to be drawn by capillarity effects through the gaps, around the ribs and into the roof, giving the impression of a leaking roof.

SUMMARY OF THE INVENTION

The present invention reduces the difficulties and disadvantages of the prior art by providing a tile which is relatively simple to manufacture by pressing a thin sheet of metal. The present tile can be installed using relatively unskilled labour due to relatively wide fitting tolerance resulting from the simplicity of the ribbed structure which cooperates with adjacent tiles. Portions of tiles which cooperate with adjacent tiles can be made to have a wide tolerance to variations in spacing between adjacent tiles, and can accommodate, to some extent, unevenness or irregularities in the roof. Furthermore, the tiles of the invention have raised rib portions which provide the stiffness which extends the full length of the tile i.e. between upper and lower tile portions , which can resist the weight of a person walking on the roof without permanent deformation. The stiffness of the tile is such that strong wind blowing upwards along the roof will have a negligible tendency to lift the tile, when compared with some prior art tiles. Also, spacing between cooperating portions of adjacent tiles is such as to reduce any tendency for capillarity effects to draw water horizontally, or slightly upwardly between adjacent tiles.

In contrast with some prior art tiles, the present tile has only two raised ribs which do not require much additional sheet stock for forming when compared with a flat unribbed tile. Also, the present tile requires a relatively small overlap with adjacent tiles, and thus relatively fewer tiles are required to cover a given area. The two factors above contribute to the overall efficiency of this present tile in covering a given roof area.

A tile according to the invention is adapted to cooperate with similar tiles to form a tiled surface. The tile is a relatively thin sheet having a periphery having first and second side edges intersecting at upper and lower corners. The edges are disposed symmetrically about a central longitudinal axis

extending between the corners and adapted so that, when the tile is installed, the central axis coincides essentially with a line defining free water flow down the tile. The tile has a lateral axis disposed normally to the central axis to divide the tile into upper and lower tile portions. The tile has first and second raised ribs having respective rib axes extending symmetrically as mirror images of each other on each side of the central axis. Each rib has upper and lower rib portions on opposite sides of the lateral axis which are interconnected so as to extend continuously between the upper and the lower tile portions to increase stiffness of the tile. The tile is further characterized in that the rib axes are mirror images of each other about the lateral axis, and the upper rib portions are generally complementary to the lower rib portions so that the lower rib portions of an upper tile can fit over upper rib portions of a lower tile. The tile also has a generally flat first side margin of the tile extending between the first side edge of the tile and an adjacent intermediate length of the first rib remote from the upper and lower corners, and a similar generally flat second side margin of the tile extending between the second side edge of the tile and an adjacent intermediate length of the second rib remote from the upper and lower corners.

A detailed disclosure following, related to drawings, described several embodiments of the invention, which is capable of expression in structure other than that described and illustrated.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a simplified top plan of a tile according to the invention,

Figure 2A is a simplified fragmented section, as would be seen partially on line 2-2 of Figure 1, with another fragmented section as would be seen from line A-A of Figure 1 superimposed thereon in broken outline for comparison of size,

Figure 2B is a simplified fragmented section on line 2-2 of Figure 1, with another similar fragmented section as would be seen from line B-B of Figure 1 superimposed thereon in broken outline to show a comparison of size,

Figure 3 is a simplified fragmented top plan of a plurality of tiles fitted together showing cooperation between adjacent tiles,

Figure 4 is a simplified fragmented section on line 4-4 of Figure 3, showing cooperation between adjacent edge portions of tiles,

Figure 5 is a simplified top plan of a second embodiment the invention, showing also additional securing means,

Figure 6 is a simplified, fragmented section on line 6-6 of Figure 5,

Figure 7 is a simplified, fragmented section similar to Figure 6 of a third embodiment of the invention.

DETAILED DISCLOSURE

Figures 1, 2A and 2B

A tile 10 is formed from a relatively thin sheet of metallic material and has a periphery disposed symmetrically about a central longitudinal axis 12. When the tile is installed, the central longitudinal axis 12 coincides essentially with a line defining free water flow down the tile, shown as an arrow 13, between upper and lower tile portions 14 and 15. The tile has first and second side edges 18 and 19 disposed symmetrically about the axis 12. The side edge 18 has generally straight upper and lower edge portions

21 and 22 respectively, and the side edge 19 has upper and lower edge portions 25 and 26. The edge portions 21 and 25 are inclined at equal angles 28 to a transverse line or lateral axis 27 which is disposed perpendicularly to the central axis 12 of the tile and divides the tile into the upper and lower portions 14 and 15. Similarly, edge portions 22 and 26 are inclined at equal angles 31 to the line 27. Preferably, the angles 28 and 31 are equal to 45 degrees, so that the portions 21 and 22, and the portions 25 and 26, are inclined to each other at 90 degrees, ignoring mitred edge portions as will be described. Upper and lower portions of the side edges 18 and 19 intersect each other at upper and lower corners 29 and 30 respectively of the tile as shown, the axis 12 extending between the corners. Angles between adjacent sides 21 and 25, and 22 and 26 are also 90 degrees, so as to define a generally square tile, which, when installed with the central axis 12 vertical resembles a generally diamond-shaped tile. As can be seen, a first mitred edge portion 33 interconnects the upper and lower edge portions 21 and 22, and a second mitred edge portion 34 interconnects the upper and lower edge portions 25 and 26. The mitred edge portions 33 and 34 are disposed symmetrically relative to the longitudinal and lateral axes 13 and 27 and provide clearance for adjacent tiles, as will be described with reference to Figure 3. First and second nail holes 35 and 36 are positioned adjacent the mitred edge portions 33 and 34, and spaced slightly upwardly from the transverse line 27. The holes receive nails, not shown, for securing to a base of the roof, such as battens or plywood sheathing, not shown. The nails and holes serve as attachment means adjacent the first and second side edges and generally adjacent the lateral axis 27 to provide an attachment to the roof approximately half way down the tile. This limits an effective moment arm of the free end or lower portion 15 of the tile for bending about the axis 27, and also permits the nail to be covered by adjacent upper tiles as will be described.

Broken lines 39 and 40 designate approximate positions of lower edge portions of two adjacent tiles (not shown) fitted over and to the left and right respectively of the tile 10. Similarly, broken lines 41 and 42

represent approximate positions of upper edge portions of two other adjacent tiles, (not shown), fitted under and to the left and right of the tile 10. This produces generally equal overlaps 43 between adjacent tiles which are important to the invention, as will be described with reference to Figure 3.

The above describes a diamond-shaped tile of very simple form, which resembles, to some extent, old fashioned relatively thick clay tiles, simple metallic or natural slates tiles. The present invention is distinguished from this basic structure by providing first and second raised ribs 45 and 46 which extend symmetrically as mirror images of each other on each side of the longitudinal axis 12. The first rib 45 has a first rib axis 47 (broken line) and upper and lower rib portions 49 and 50. Similarly, the second rib 46 has a second rib axis 48 (broken line) and upper and lower rib portions 51 and 52. The rib axes are central axes of the respective ribs and thus also extend as mirror images of each other on each side of the longitudinal axis 12. The upper and lower rib portions of each rib are interconnected so as to extend continuously and smoothly between the upper and lower tile portions 14 and 15 to increase stiffness of the tile relative to a flat plate. As seen in Figure 2A, the rib 45 has a convex upper rib surface 54 and a concave lower rib surface 55, the rib surfaces being spaced apart by thickness 56 of the rib which approximates to thickness of a centre portion 57 of the tile. Thus the tile has an essential equal thickness throughout and can be made by simply pressing a thin gauge steel of about 0.5 mm thickness (about 27 gauge), suitably treated for corrosion resistance and preferably coated with a fine mineral granules. The granules appear to increase fitting tolerance and tend to reduce capillary action between close fitting portions of tiles. The rib 46 is similarly shaped, so that both ribs have upper convex surfaces on the same side as the tile. The first and second ribs 45 and 46 are spaced inwardly from the adjacent first and second side edges 18 and 19 to define generally flat first and second side margins 59 and 60 respectively of the tile. It is noted that the first side margin 59 extends between the respective first side edge 18 of the tile and an adjacent first intermediate

length 67 of the first rib 45 remote from the upper and lower corners 29 and 30. Similarly the second side margin 60 extends between the respective second side edge 19 of the tile and an adjacent intermediate length 68 of the second rib 46 remote from the upper and lower corners. The intermediate lengths of the ribs are defined more fully later. The central portion 57 is generally flat and coplanar with the first and second side margins 59 and 60, as best seen in Figures 2A and 2B.

To enable adjacent tiles to cooperate with each other, in this embodiment the upper rib portions 49 and 51 are smaller than the lower rib portions 50 and 52 respectively, so that the lower rib portions of an upper tile can fit over upper rib portions of a lower tile. Thus the upper rib portions are generally complementary to the lower rib portions. Thus it can be seen that the rib axes of the upper and lower rib portions are also mirror images of each other about the lateral axis 27, so that the tile, or at least axes of the ribs, are essentially symmetrical about both the central and lateral axes 12 and 30 respectively. To attain a relatively close fit between upper and lower tiles, it is essential that the rib portions do not interfere prematurely with each other, so that coplanar flat portions of the tiles on either side of the rib portions can contact each other, as will be described with reference to Figure 4. While it is not necessary that the engaging upper and lower surfaces of the rib portions and adjacent tile portions are exactly complementary to each other, the lower rib portion should be no greater in height or width than the maximum that can fit closely underneath the upper rib portion. To avoid prior art problems relating to the capillarity effect between closely fitting tiles, that is the ability of water to be drawn upwardly through a narrow gap between adjacent tiles, preferably there should be some reasonable clearance between edges of two tiles. This clearance can be of the order of 0.5 millimetres, or slightly greater and this should prevent excessive problems due to capillarity, and will also permit greater tolerance in manufacturing and fitting of tiles.

In Figure 2A, the plane of section shown in full outline is taken on the central axis 27, and intersects the first raised rib 45 at an transition rib portion 62, which is at a position intermediate of the upper and lower rib portions 49 and 50. The transition rib portion 62 connects the upper and lower rib portions 49 and 50. The partial section shown in broken outline is taken on the upper rib portion 49, and it can be seen that the upper rib portion is smaller in cross-section than the transition rib portion 62. As drawn, a lower surface 61 of the upper rib portion 49 is spaced from the lower surface 55 of the transition rib portion 62 by an amount equal approximately to one half of the thickness 56 of the plate. This is not critical, but for this particular embodiment this is the preferred difference in positions of the lower surface.

The transition rib portion 62 is a portion of a curve or arc centred on point 64, which is disposed on the axis 27. The transition rib portion 62 is defined by an arc 65 positioned between intersections of the first rib 45 with the broken lines 39 and 41 which represents the position of the edges of adjacent tiles. The arc 65 subtends an angle 66 at the point 64, which is typically about 10-20 degrees, although this can vary depending on the overlap of the tile and the shape of the first rib.

The upper rib portion 49 has an essentially constant cross-section from an upper end 69 adjacent the upper edge portion 21 of the tile to a lower connection 70 with the transition portion 62. Similarly, the lower rib portion 50 has an essentially constant cross-section from an upper connection 73 with the transition portion 62 to a lower end 74 adjacent the lower edge portion 22 of the tile. It can be seen that each upper rib portion, as defined above by its constant cross-section, has a generally shallow S-shape with a generally straight mid portion 77 disposed between upwardly and downwardly curved upper and lower terminal portions 78 and

79. The mid portion is generally parallel to the adjacent upper side edge portion 21. Similarly, the lower rib portion 50 has an essentially constant cross-section and a generally shallow S-shape with a generally straight mid portion 82 disposed between upwardly and downwardly curved upper and lower terminal portions 83 and 84. The mid portion 82 is generally parallel to the adjacent lower side edge portion 22. It can be seen that the intermediate length 67 of the rib 45 includes the two straight mid portions 77 and 82, the transition portion 62 and the terminal portions 79 and 93 interconnecting the portions above. Most of the terminal portions 78 and 84 adjacent and intersecting the edges 21 and 22 considered to be too close the the edges to be included in the intermediate length 67.

The second raised rib 46 has a cross-section which varies similarly to the rib 45 and has a transition rib portion 63 which is generally similar to the portion 62 of the first raised rib, but is a mirror image thereof about the axis 12. Thus the raised rib 46 has upper and lower terminal portions 86 and 87 which intersect the edges 25 and 26 adjacent the corners 29 and 30. The intermediate length 68 remote from the corners 29 and 30 similarly does not include most of the terminal portions 86 and 87. As can be seen in Figure 2B, the lower rib portion 52 has a cross-section shown partially in broken outline that is larger than the cross-section of the transition rib portion 63, which is identical in size to the portion 62 of Figure 2. Each upper rib portion is thus connected smoothly to the respective lower rib portion by a respective transition rib portion. The transition rib portion has a size which increases from intersections with the upper rib portion to the lower rib portion to provide a continuous transition between the adjacent rib portions so that the lower rib portions of an upper tile can fit over the upper rib portions of a lower tile, and so that the tile has continuous stiffening ribs extending between upper and lower tile portions.

As can be seen in Figure 1, the upper terminal portions 78 and 86 of the

upper rib portions 49 and 51, and the lower terminal portions 84 and 87 of the lower rib portions 50 and 52 are spaced apart by spacings 88 and 89 respectively to provide clearance therebetween to permit water to pass easily down the tile. Also, the upper and lower terminal portions of the rib portions curve smoothly upwardly and downwardly respectively to intersect side edges of the tile adjacent the upper and lower corners 29 and 30 respectively, and curvatures of the terminal portions are generally equal to each other, so as to permit complementary overlapping of the rib portions as previously described, and as described in more detail with reference to Figures 3 and 4.

OPERATION

Figures 3 and 4

The roof which is to be tiled can be fitted with longitudinally extending battens, not shown, or plywood sheathing, depending on conventional building practice. If battens are used, space between adjacent battens corresponds to space between nail holes of adjacent tiles, which is approximately one half of the length of the tile measured along the axis 12. For any roof structure the method of installing the tiles is essentially the same.

Tiles are first laid along the lower portion of the roof, preferably in horizontal lines extending from end to end of the roof. Adjacent horizontal rows of tiles are installed, one upon the other, working progressively up towards the ridge of the roof.

Figure 3 shows portions of five horizontal rows of tiles, the rows designated 91 through 95 moving progressively up the roof. Mitred portions of adjacent tiles in the same row are closely adjacent each other. Four nails

97, shown in broken outline, secure some tiles of the row 93, and are in themselves covered by lower portions of side margins of the tiles in an upper row 94. Similarly nails 98 secure the tiles of the row 92 and are covered by side margin lower portions of the tiles in row 93. Edges of tiles that are covered by side margins of other tiles are shown in broken outline, and it can be seen that all tile edges are well overlapped to reduce chances of water passing between tiles, either by wind force, water flow or capillarity.

For convenience of explanation, the tile 10 is shown as the central tile in the row 93 and it can be seen that the downwardly curved lower terminal portions 84 and 87 of the lower rib portions 50 and 52 merge smoothly with the transition rib portions 105 and 106 respectively of two lower tiles 108 and 109 in the row 92. Similarly, lower terminal portions 110 and 111 of tiles 112 and 113 in the upper row 94 overlap and merge smoothly with the intermediate portions 62 and 63 of the tile 10. Water flowing down the roof in direction of the arrow 13 is restricted only slightly by the continuous S-shaped curves of raised ribs which never totally obstruct water flow. It is seen that the lower rib portions 50 and 52 of the tile 10 overlap completely upper rib portions, not shown in Figure 3, of the tiles 108 and 109. Similarly, lower rib portions 116 and 117 of the tiles 112 and 113 overlap completely upper rib portions 49 and 51, not shown in Figure 3, of tile 10.

The overlapping between the lower rib portions of the upper tile and upper rib portions of a lower tile are more clearly seen in Figure 4 which shows cooperation between the tiles 112, 10 and 109. The rib portion 116 is shown overlapping the rib portion 49, and the rib portion 52 of the tile 10 is shown overlapping upper rib portion 118 of the tile 109. The overlapping rib portions are shown to be exactly complementary, but this is not necessarily desirable or practical for tiles manufactured and installed to normal tolerances.

ALTERNATIVES AND EQUIVALENTS

The tile 10 is shown as a square tile, with two oppositely mitred corners. Thus, angles between the four main edges of the tile are 90 degrees, and in general edges of the tile are equal in length. While this provides a conventional and pleasing tile appearance, variations of the overall shape of the tile are possible, provided the opposite side edges are disposed as mirror images about the axis 12, and the adjacent side edges are mirror images about the axis 27.

Also, in Figures 2A, 2B and 4, it can be seen that the cross-sections of the rib portions of each tile are generally complementary to each other, that is the ribs are a portion of an arc which merges smoothly with large radii into adjacent flat portions of the centre portion of the tile, and coplanar side margins of the tile. Clearly, upper portions of the lower tile which are overlapped by an upper tile could be of a different shape, and considerably smaller than under surfaces of the corresponding upper tile. This would permit a greater tolerance to installing the tiles, and, in some cases, reduces chances of water being drawn by capillarity across the rib portions. The ridges could be different cross-sections, i.e. triangular, partially trapezoidal etc., as seen in Figures 6 and 7.

Also, as defined, the upper rib portion has the smallest constant cross-section, the lower rib portion has the largest constant cross-section, and the transition rib portion has a variable cross-section which changes smoothly fron the smallest cross-section to the largest cross-section over a short arc 65 to provide the transition in sizes of ribs. In an alternative raised rib, (not shown), the cross-section could vary essentially continuously from the smallest adjacent the upper side edge (e.g. equivalent to the rib upper end 69 at the edge 21) to the largest adjacent the lower side edge (e.g. equivalent to the rib lower end 74 adjacent the edge 22). This would effectively

eliminate the short transition rib portion (e.g. 62,63) because the whole length of the raised rib would have a gradually changing cross-section which would still be generally complementary to adjacent ribs to provide cooperation as previously described. In yet another alternative, portions of the upper rib portion could be of one constant cross section, portions of the lower rib portion would be of a larger constant cross sections and the intermediate portions could extend over a larger arc than shown to interconnect the upper and lower portions. Many variations are possible, within the broad concept of the upper rib portions being smaller than and complementary to the lower rib portions where the tiles overlap.

While the preferred material of manufacture is corrosion resistant steel, alluminum alloy or suitably reinforced plastic could be substituted.

Figures 5 and 6

An alternative tile 120 has first and second side edges 121 and 122 which define a generally diamond shaped tile with mitred opposite edge portions 123 and 124 respectively. The tile has a central longitudinal axis 125 which intersects at right angles a lateral axis 127 interconnecting the mitred edge portions 123 and 124, similarly to the tile 10 of Figures 1 through 4.

A main difference between the tile 120 and the tile 10 relates to the raised ribs. The tile 120 has first and second raised ribs 131 and 132 respectively which are disposed as mirror images of each other about the axis 125. In contrast with the variable sectioned raised ribs 45 and 46 of Figures 1 through 4, the ribs 131 and 132 have equal and constant cross-sections extending from adjacent an upper corner 137 of the tile towards a lower corner 138, that is along the complete lengths thereof. Thus the rib 131 has upper and lower rib portions 134 and 135 of constant cross-section, and the rib 132 has upper and lower rib portions 139 and 140 of constant cross-

section, all cross-sections being equal. Thus the transition rib portions 62 and 63 of Figures 1 through 4 are eliminated as there is no change in cross-section along the length of the ribs. This has several advantages, for example it simplifies tooling, and a suitable cross-section of rib also permits generally parallel stacking of similar tiles one on top of the other for storage and transportation, without undue interference between portions of the ribs. Similarly to the tile 10, a generally flat side margin 141 of the tile extends between the first side edge 121 and an adjacent intermediate length 147 of the first rib 131 remote from the upper and lower corners 137 and 138. A similar generally flat second side margin 142 of the tile extends between the second side edge 122 and an adjacent intermediate length 148 of the second rib 132 remote from the upper and lower corners. Clearly, a centre portion 145 of the tile 120 and the first and second side margins 141 and 142 of the tile are co-planar, and would contact similar centre portions and flat side margins when the tiles are stacked. The smoothly curved, partially circular cross-section of the tile 10, as shown in Figures 2A, 2B, and 4, is appropriate provided the above criteria are met. Alternatively, the raised ribs 131 and 132 can have a generally triangular cross-section, as shown in Figures 6, which applies to the whole length of the rib. In general, if the tile is formed from a thicker material, side walls of the raised ribs would be inclined more shallowly to prevent premature interference when fitting on the roof, or when stacking. A rib 149 of an adjacent tile is shown in broken outline and reflects the complementary ribs when the tiles are set on a roof or when stacked.

First and second nail holes 151 and 152 are adjacent the mitred edge portions 123 and 124 respectively, and positioned slightly above the axis 127 as described for the tile 10. A third nail hole 153 can be provided adjacent the lower corner 138 and thus would be appropriate if the tile were expected to be subjected to exceptionally high wind speeds e.g., as encountered in a tropical storm. Thus it is an additional safety feature which would not be

required for many environments. In contrast with the holes 151 and 152, the hole 153 would not be covered by adjacent tiles, and thus additional sealing of hole would be required, usually witha resilient washer. Nails, not shown, together with the respective nail holes, serve as attachment means as before.

Thus, in summary, it can be seen that the ribs of the alternate tile 121 are also mirror images about the lateral axis 127, as well as about the central longitudinal axis 125. This contrasts with the tile 10 of Figure 1, where only the rib axes 47 and 48 of the ribs are mirror images about the lateral axis 27, in view of the difference between the cross-sections of the ribs 45 and 46 on opposite sides of the transverse lateral axis 27. Furthermore, if the locations of the nail holes 151 - 153 are ignored, the tile 120 is now essentially symmetrical about the transverse axis 127 as well as about the axis 125. This two-axis symmetry also permits the tile to be inverted because the upper and lower tile portions are essentially identical. This provides another advantage arising from the difference between the tiles 10 and 120 as follows. Cut portions or remnants of tiles that are produced when covering a roof can be more easily used, thus reducing waste. For example, a roof with dormer windows or several changes of roof line requires many tiles to be cut to size to fit awkward places, and it is more likely that the resulting tile remnants would be usable when the raised ribs have a constant cross-section along their length and the tile has two-axis symmetry.

Figure 7

Figure 7 shows another an alternative cross-section of a raised rib 155 which shows a truncated triangular shaped section or partially trapezoidal section which would also permit use of a rib of constant cross-section.

CLAIMS

1. A tile (10,120) adapted to cooperate with similar tiles (108,109,112,113) to form a tiled surface, the tile being a relatively thin sheet having a periphery having first and second side edges (18,19; 121,122) intersecting at upper and lower corners (29,30; 137,138) the periphery being disposed symmetrically about a central longitudinal axis (12,125,) extending between the corners and adapted so that, when the tile is installed, the central axis coincides essentially with a line (13) defining free water flow down the tile, the tile having a lateral axis (27,127) disposed normally to the central axis (12,125) to divide the tile into upper and lower tile portions (14,15), the tile having first and second raised ribs (45,46; 131,132) having respective rib axes (47,48) extending symmetrically as mirror images of each other on each side of the central longitudinal axis (12,125), each rib having upper and lower rib portions (49,50, 51,52; 134,135,139,140) on opposite sides of the lateral axis (27,127) which are interconnected so as to extend continuously between the upper and the lower tile portions (14,15) to increase stiffness of the tile, the tile being further characterized in that:

   (a) the rib axes (47,48) are mirror images of each other about the lateral axis (27,127), and the upper rib portions (49,51; 134,139) are generally complementary to the lower rib portions (50,52;135,140) so that the lower rib portions of an upper tile can fit over upper rib portions of a lower tile,

   (b) a generally flat first side margin (59,141) of the tile (10,120) extends between the first side edge (18,121) of the tile and an adjacent intermediate length (67,147) of the first rib (45,131) remote from the upper and lower

corners (29,30; 137,138), and a similar generaly flat second side margin (60,142), of the tile extends between the second side edge (19,122) of the tile and an adjacent intermediate length (68,148) of the second rib (46,132) remote from the upper and lower corners.

2. A tile as claimed in claim 1 further characterized in that:

(a) the upper rib portion (49,51; 134,139) of each rib (45,46; 131,132) has a convex upper rib surface (54),

(b) the lower rib portion (50,52; 135,140) of each rib (45,46; 131,132) has a concave lower rib surface (55) which is generally complementary to the convex upper rib surface (54), so as to permit the lower rib portion of the upper tile to fit closely over the upper rib portion of the lower tile.

3. A tile as claimed in claim 1 further characterized in that:

(a) the tile has a generally flat centre portion (57,145) which is generally coplanar with the first and second side margins (59,60; 141,142) of the tile.

4. A tile as claimed in claim 1 further characterized in that:

(a) each side edge (18,19; 121,122) having generally straight upper side edge and lower side edge portions (21,25; 22,26) which are inclined at equal angles (28,31) to the lateral axis (27,127) of the tile to define a generally diamond shaped tile.

5. A tile as claimed in claim 1 further characterized in that:

(a) each side edge (18,19; 121,122) having generally straight upper side edge and lower side edge portions (21,25; 22,26) which are inclined at equal angles (28,31) to the lateral axis (27,127) of the tile to define a generally diamond shaped tile,

(b) each upper rib portion (49,51; 134,139) has a generally shallow S-shape with a generally straight mid portion (77) disposed between upwardly and downwardly curved upper and lower terminal portions (78,79), the mid portion (77) being generally parallel to an adjacent upper side edge portion (21),

(c) each lower rib portion (50,52; 135,140) has a generally shallow S-shape with a generally straight mid portion (82) disposed between upwardly and downwardly curved upper and lower terminal portions (83,84), the mid portion being generally parallel to an adjacent lower side edge portion (22).

6. A tile as claimed in claim 1 further characterized in that:

(a) each upper rib portion (49,57) is connected smoothly to the respective lower rib portion (50,52) by a respective transition rib portion (62,63), the transition rib portion having a size which increases from the upper rib portion (49,51) to the lower rib portion (50,52) to provide a transition between the rib portions so that the lower rib portions of an upper tile can fit over the upper rib portions of a lower tile,

(b) each upper rib portion (49,51) has an essentially constant cross-section from an upper end (69) adjacent the upper edge portion (21) of the tile to a lower connection (70) with the transition portion (62),

(c) each lower rib portion (50,52) has an essentially constant cross- section from an upper connection (73) with the transition portion (62) to a lower end (78) adjacent the lower edge portion (22) of the tile.

7. A tile as claimed in claim 1 further characterized in that :

(a) the upper and lower rib portions (49,51,50,52; 134,139,135,139) have upper and lower terminal portions (78,83; 79,84) respectively which are spaced apart to provide clearance (88,89) therebetween to permit water to pass easily down the tile,

(b) the upper and lower terminal portions (78,83; 79,84) of the rib portions curve smoothly upwardly and downwardly respectively to intersect side edges (18,19; 121,122) of the tile adjacent the upper and lower tile portions (14,15) respectively.

8. A tile as claimed in claim 4 or 5 further characterized in that:

(a) a first mitred edge portion (33,123) interconnects the upper and lower edge portions (21,22) of the first side edge (18,121),

(b) a second mitred edge portion (34,124) interconnects the upper and lower edge portions (25,26) of the second side edge (19,122), the first and second mitred edge portions being disposed symmetrically relative to the central axis (12,125) and the lateral axis (27,127) line.

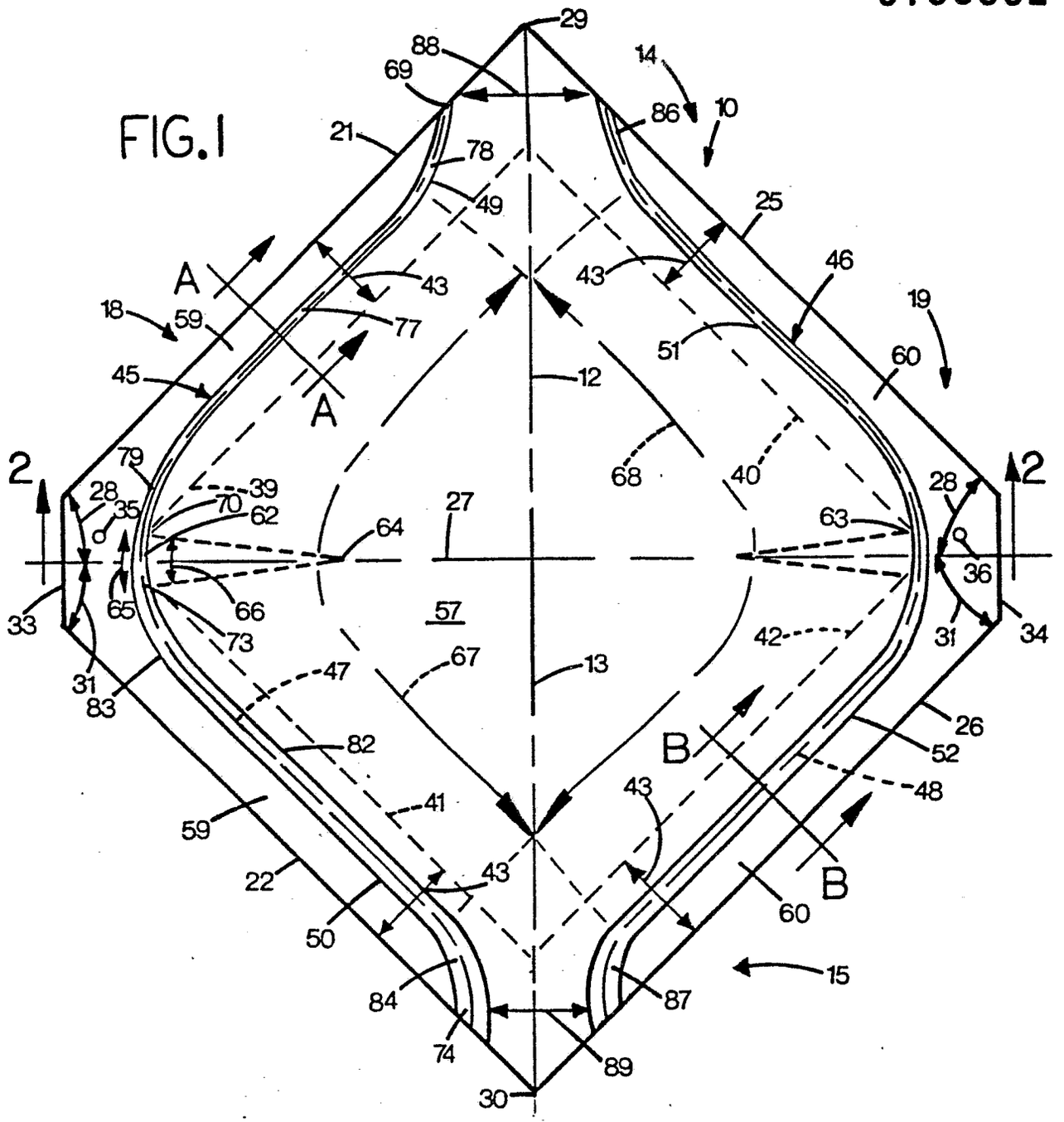
9. A tile as claimed in claim 1 further characterized in that:

(a) attachment means (35,36) are provided adjacent the first and second side edges (18,19), so as to be generally adjacent the lateral axis (27,127) line.

10. A tile as claimed in claim 1 further characterized in that:

(a) the upper and lower rib portions (134,139; 135,140) have essentially equal and constant cross-sections along complete lengths thereof.

FIG.1



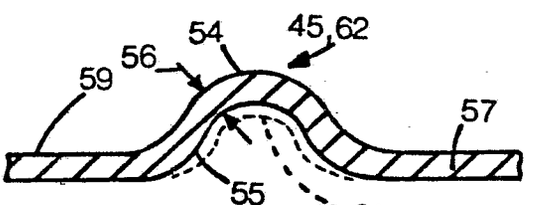


FIG.2A

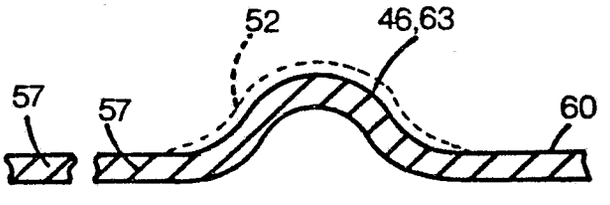


FIG.2B

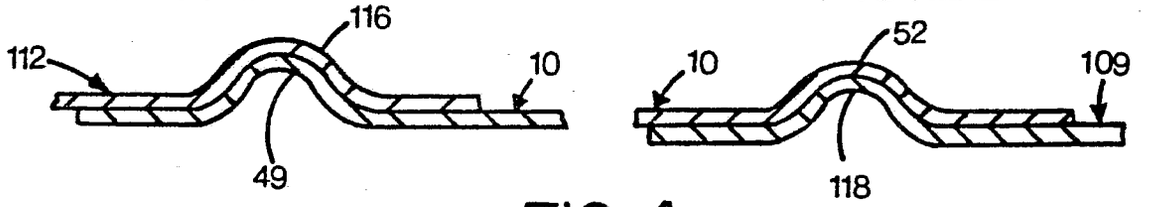


FIG.4

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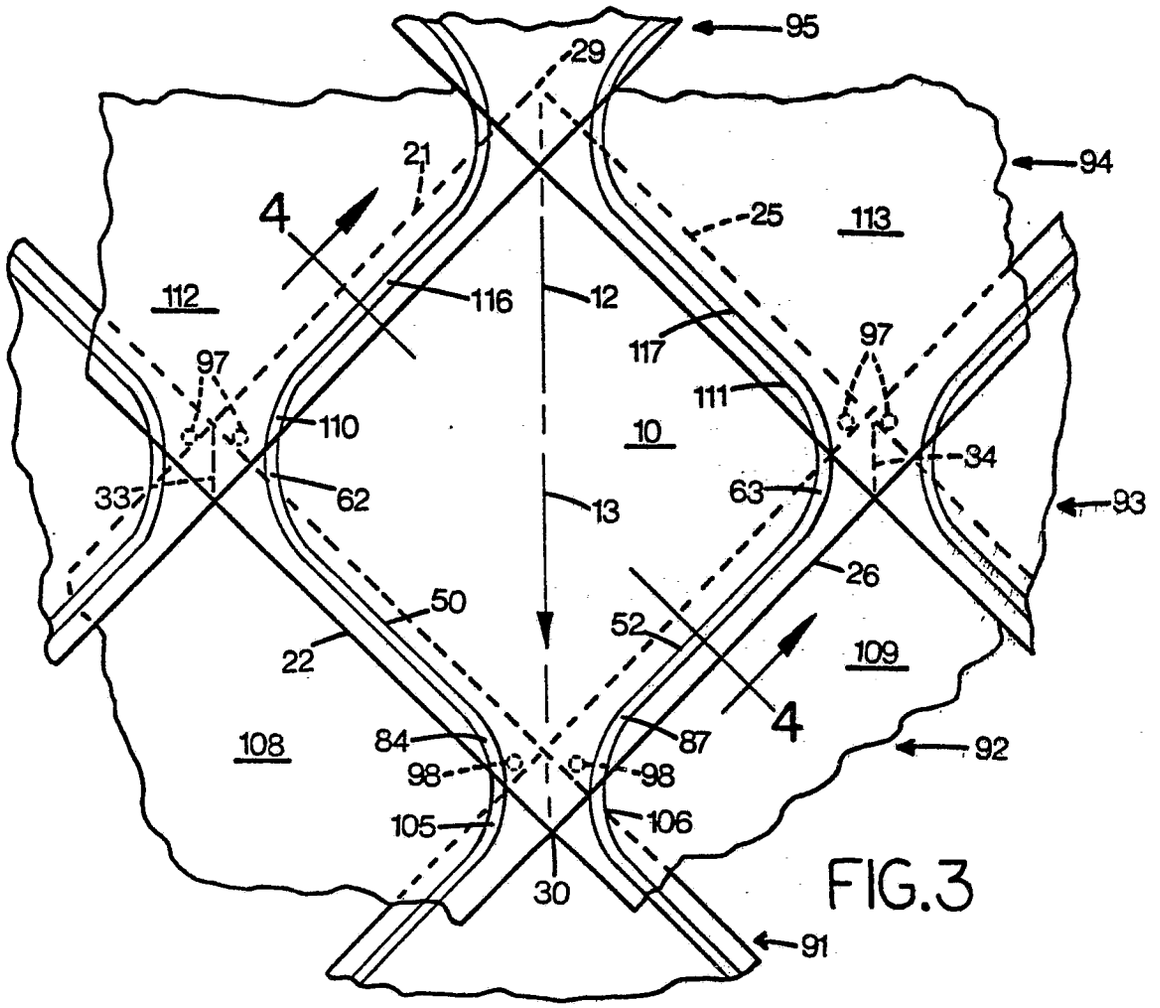

FIG.3

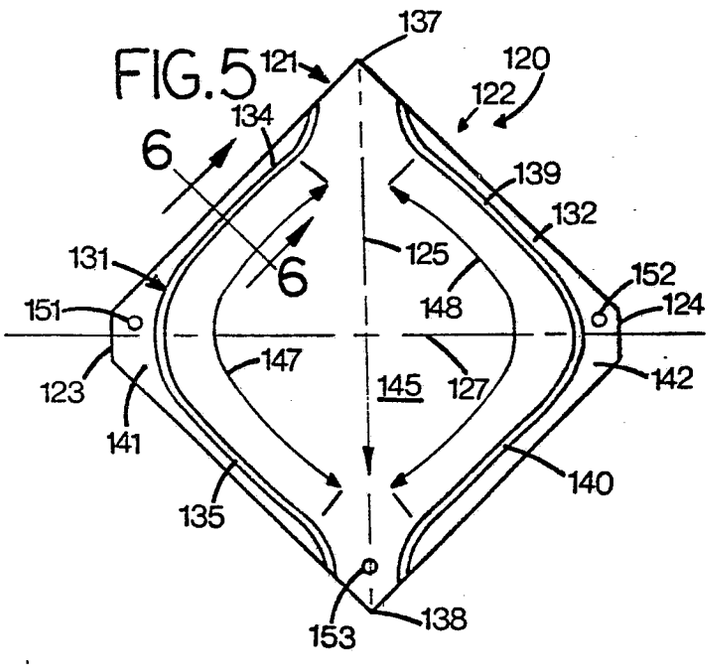

FIG.5

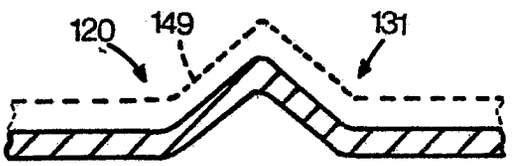

FIG.6

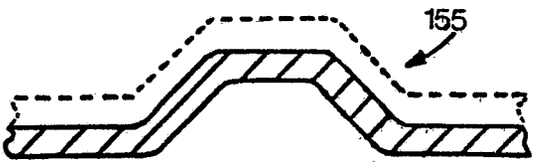

FIG.7