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(54) **Insulating panel retainers for roof construction.**

(57) Clips for retaining insulation boards for flat roofs are provided, the retainers comprising generally spaced apart parallel plate-like members joined to each other by two generally planar webs, the webs being disposed generally normal to each other and to the plate like members.

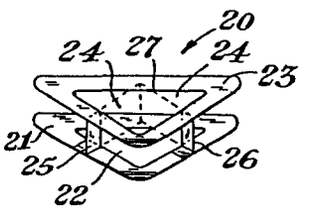

Fig. 1

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INSULATING PANEL RETAINERS FOR ROOF CONSTRUCTION

For many years, so-called flat roofs have been popular for many applications as they can be installed at relatively low cost. Such flat roofs generally consist of a roof deck having a water impermeable membrane disposed thereon. In many cases the water impermeable membrane is comprised of layers of felt impregnated with bitumen or tar and adhered together by means of bituminous adhesive. Oftentimes the membrane was covered with a layer of gravel. Upon prolonged exposure to sun and the atmosphere, volatile materials would be lost from the water impermeable membrane resulting in shrinkage, fracture of the membrane and subsequent roof leaks.

Significant improvements were made in such roofing as set forth in U.S. Letters Patent 3,411,256. A variety of panels have been employed for roof structures generally of the flat roof nature and typified by those disclosed in U.S. Patents 3,029,172; 3,266,106; 4,067,164; and 4,045,934. U.S. 3,476,634 discloses a mode of fastening low density insulating panels in edge to edge relationship by means of a connector disposed between

the panels which has projections which enter adjacent edges of the panels.

Particularly desirable roofing panels are of generally low density closed cell, generally water impermeable, synthetic resinous foam; for example, polystyrene foam. Generally, such foam is protected from ultraviolet radiation by means of a layer of gravel disposed over the closed cell insulating boards which usually are of a rectangular configuration. Such roofs in most insulation applications have been very successful in that the thermal insulation disposed over the water impermeable membrane reduces significantly the maximum temperature reached by the roof membrane. Moreover, deterioration of the roof membrane from exposure to sunlight and severe thermal cycling is significantly reduced. Occasionally such insulation is applied to roof decks which are not perfectly flat but which have depressed areas where water may collect. If such depressed areas are sufficiently large, a considerable force may be exerted by the insulation on the membrane where the water has collected and tends to cause the closed cell thermal insulation to float. In the event that the insulation is adhered to the membrane, stress is applied to the membrane. In the event that the insulation is not adhered to the membrane, and the insulation floats and if wind is sufficiently strong, the gravel layer may become displaced and the insulating members displaced relative to one another. In order to avoid such displacement, one proposal is to apply a water permeable material to the upper surface of the insulating elements and bond such permeable material thereto to aid in maintaining the thermally insulating elements in a desired position relative to one another

and prevent smaller gravel particles working their way between or beneath the insulating members, thus increasing the difficulty of repair. The collection of water in depressed areas is generally referred to as "ponding". The phenomenon of ponding is not necessarily present from the time of construction of the roof but may develop as the building ages, so that what may have been an initially satisfactory roof may become through movement of the structure, such as sagging thereof, an unsatisfactory roof. In other instances depending upon the parapet or like thereof above a roof structure, or other projections or structures added to the roof, under high wind conditions localized areas of the roof may have the gravel layer severely displaced during wind storms. Thus in the event of ponding in such areas where what might be considered the gravel ballast has been removed from one or more of the insulating elements, a substantial force exists which tends to displace an unweighted or ballasted insulating element relative to its neighbors.

It would be desirable if there were available an improved thermally insulated roof having a reduced tendency for thermal insulating elements to be displaced from one another.

It would also be desirable if there were available an improved and simple means of preventing displacement of roof insulating elements relative to one another.

It would also be desirable if there were an improved method for the preparation of a thermally insulated roof wherein adjacent thermal insulating

elements were not readily displaced relative to one another.

It would also be desirable if there were an improved means for engaging adjacent roof insulating elements to prevent displacement relative to one another.

These benefits and other advantages are achieved in a roof insulating element retaining device, said device comprising a first generally planar member, a second generally planar member in spaced parallel relationship to the first planar member; first and second connecting webs disposed between and generally normal to planes of the generally planar members, the first and second webs being disposed generally normal to each other, said retaining device being adapted to engage at least two corners of adjacent thermally insulating elements and at least a portion of a third insulating element.

Advantageously in an alternate embodiment, the retaining device is adapated to engage four adjacent corners of four insulating elements.

Also contemplated within the scope of the present invention is a thermally insulated roof employing the retaining devices of the present invention.

Also within the scope of the present invention is a method of preparing a built-up roof, the method comprising applying and affixing to a roof deck a water impermeable membrane, disposing on the water

impermeable membrane a plurality of closed cell water impermeable thermal insulating members defining fissures between adjacent members, the improvement which comprises affixing adjacent thermal insulating members to each other by means of a retaining device comprised of first and second spaced apart generally parallel planar elements, the generally planar elements being maintained in spaced apart fixed relationship by means of at least two webs, each of the webs being affixed to the planar members and the webs being disposed generally normal to each other and to the planar members, said retaining devices engaging at least three adjacent insulating members.

Further features and advantages of the present invention will become more apparent from the following specification taken in connection with the drawing wherein

Figures 1 to 3 provide three views of one embodiment of the invention;

Figure 3A shows a plan view of an alternate embodiment of the invention;

Figures 4 to 12 depict views of alternate embodiments of the invention;

Figure 13 is a schematic representation of a flat roof wherein adjacent thermal insulating elements are affixed to each other with a retainer generally similar to that depicted in Figures 3 and 3A; and

Figure 14 depicts a schematic fractional representation of a roof in accordance with the present invention employing a retaining device such as is depicted in Figures 1-12.

In Figure 1 there is schematically depicted an isometric view of a retainer or clip in accordance with the invention generally designated by the reference numeral 20. The retainer 20 comprises a first generally triangular planar element 21 having a generally triangular cutout 22 generally centrally disposed therein. In parallel fixed spaced relationship to the planar element 21 is a second generally planar element 23 of generally like configuration to element 21 having a generally triangular cutout portion 24. The planar elements 21 and 23 have the general configuration of a right triangle wherein the corners thereof have been rounded. A first web 25 is affixed to the planar elements 21 and 23. The web 25 is disposed generally normal to the planes of the planar elements 21 and 23. A second web 26 spaced from the first web 26 is generally normal to the planes of the planar elements 21 and 23. The planes of the webs 25 and 26 are generally normal to each other. The dotted configuration indicated by the reference numeral 27 indicates a projection of the planes of the webs 25 and 26 to an intersection location within a space between the planar elements 21 and 23.

Figure 2 depicts a plan view of the retainer 20 of Figure 1 showing the locations of the webs 25 and 26 which are disposed on the sides of the triangular elements 23 and 21 generally remote from the hypotenuse of the triangular configuration.

Figure 3 is an edge view of the retainer 20 showing the relationship of the planar elements 21 and 23 and the webs 25 and 26.

The retainer of Figures 1, 2 and 3 is particularly suited and adapated for engaging at least 2 corners of an adjacent panel and a side of a third panel, or alternatively four adjacent corners of four adjacent panels. With reference to Figure 1, if the dotted configuration 27 is projected to form a cross, the location of the four adjacent corners of four adjacent panels is obtained.

In Figure 3A, there is depicted an alternate embodiment of a retainer 20a comprising a generally planar cutout triangular element 23a in fixed parallel relationship to a second triangular element of like configuration separated by a first web 25a and a second web 26a. The webs 25a and 26a are affixed to the planar elements 21a and 23a. The webs 25a and 26a are disposed generally normal to the planes containing elements 21a and 23a. The webs 25a and 26a are disposed generally normal to each other. The dotted configuration indicated by the reference numeral 27a indicates intersection of the projected planes of the webs 25a and 26a.

In Figure 4 there is depicted an alternate retainer 40 comprising a first or upper square plate 41, and a second or lower square plate 42 parallel to plate 41. Plates 41 and 42 are separated by a first web 43 and a second web 44. The planes of the webs 43 and 44 are generally normal to each other and normal to planar members 41 and 42.

In Figure 5 there is depicted an alternate retainer 50 comprising a first square plate 51 and a second square plate 52. Each of the square plates 51 and 52 defines a square opening, the openings being generally designated by the reference numeral 53. The plates 51 and 52 are in fixed parallel relationship to each other and are separated by means of webs 54 and 55. The webs 54 and 55 and the plates 51 and 52 are arranged in a similar manner to that of the retainer 40 of Figure 4.

In Figure 6 there is depicted a retainer 60 having a first generally planar circular member 61. A second generally planar circular member 62 is in fixed parallel coaxial relationship with member 61. The circular members 61 and 62 each define a generally circular opening 63. The planar elements 61 and 62 are maintained in fixed spaced relationship by means of a first web 64 and a second web 65. The webs 64 and 65 are arranged in a similar manner as are the webs 43 and 44 of the retainer 40 of Figure 4.

In Figure 7 there is depicted a retainer 70 having a generally circular planar element 71, a second circular element 72 coaxially arranged with respect to the element 71. The planar elements 71 and 72 are separated by webs 73 and 74 which have planes generally normal to each other and normal to the planar elements 71 and 72.

In Figure 8, there is depicted a retainer 80 comprising a first triangular plate 81; a second triangular plate 82 which is in fixed parallel relationship with respect to plate 81. The plates 81

and 82 are separated by webs 83 and 84. Plates 81 and 82 generally have the configuration of a right triangle. The webs 83 and 84 are in planes generally normal to each other and to the planes of plates 81 and 82. The planes of the webs 83 and 84 intersect within spaces enclosed by the peripheries of the plates 81 and 82.

In Figure 9 there is depicted a retainer 90 comprising a first and generally L-shaped planar member 91 and a second generally L-shaped planar member 92; the members 91 and 92 being maintained in a fixed spaced apart relationship with respect to each other by a first web 93 and a second web 94. The webs 93 and 94 extend generally parallel to the legs of the L-shaped members 91 and 92 and are disposed generally at right angles to each other and to the planar members 91 and 92.

In Figure 10 there is depicted a retainer 100 comprising a first generally planar member 101 and a second generally planar member 102; each of the members 101 and 102 having a generally planar octagonal configuration. The members 101 and 102 are maintained in a fixed, spaced relationship to each other by means of webs 103 and 104. The webs 103 and 104 lie in planes generally normal to each other and normal to the planar elements 101 and 102.

In Figure 11 there is schematically depicted an exploded isometric view of a retainer 110 comprising a first or upper generally triangularly-shaped plate 112 and a second or lower generally triangularly-shaped plate 114. The upper plate 112 is provided with a slot 113 in each of two legs of the plate and extending in a

direction generally normal or perpendicular to each other and to the longitudinal direction of the leg in which each slot is provided. The lower plate 114 is provided with an upstanding web 115 and 116, respectively, on each of two legs of the lower plate and positioned so that the webs will extend through their respective slots 113 when the upper plate is positioned in a juxtaposed and parallel position with respect to the lower plate 114. Each of the webs is cut centrally and longitudinally thereof, as shown at 117, to provide a pair of tabs 118 and 119. In practice, the lower plate of the retainer is positioned below the insulating panels, i.e., between the bottom surface of the panels and a roof structure, so that panels are positioned in the same manner as described with respect to the retainer of Figures 1 to 3. With the tabs 118 and 119 extended above the upper surfaces of the insulating panels, the upper plate 112 is placed in a position with respect to the lower plate such that the slots 113 are in registry with the tabs of the respective webs. The upper plate 112 is then positioned such that the tabs extend through the slots and until the plate is in abutment with the upper surfaces of the insulating panels. The tabs 118 and 119 are then bent outwardly, as shown by the arrows in Figure 11A to lock the upper plate into position to firmly hold the corners and surfaces of the panels in an adjacent relationship with respect to each other. The depth of the cut 117 is sufficient to allow for an adjustment in the spacing of the plates 112 and 114 with respect to each other and in order to accommodate insulating plates of different thicknesses.

Each of the plates 112 and 114 is shown with a cutout 111. It will be apparent, however, that the slots 113 may weaken the plates where they are more easily bent along the longitudinal axis of the slots. If that should pose a problem, it is a simple expedient to provide the upper plate with a smaller cutout or with a plurality of smaller cutouts to thus strengthen or provide additional stiffness to the plate.

In order to prevent puncturing or tearing of the underlying roofing structure, such as a water impermeable sheet of a synthetic resinous material, it is also preferable to provide the lower surface of the retainer plate 114 with a rounded surface as illustrated at 114a.

It will be apparent that the adjustable feature illustrated in the embodiment of Figures 11 and 11A is equally as well applicable to the retainer embodiments illustrates in Figures 1 through 10.

A further modification of an adjustable retainer, similar to the retainer illustrated in Figures 11 and 11A, is shown in Figure 12. There, a generally triangular retainer 120, shown in an exploded, part--sectional view, comprises an upper plate 122 provided with a slot 123, and a lower plate 124 provided with an upstanding web 125. The web is provided on opposite sides thereof with a plurality of ribs 126 although it will be obvious that the ribs may be provided on only one side of the web. The ribs 126 are sufficiently soft or flexible such that the web with the projecting ribs can be forced through the slot 123 and to a depth where the upper plate 122 is securely held against the

upper surfaces of the insulating panels positioned between the upper and lower plates. The ribs 126 will thus lock the upper plate in a predetermined position depending on the thickness of the insulating panels to be held in an edge to edge relationship on the roof structure. For ease of insertion of the web 125 into the slot 123, the upper surface of the web is rounded out as shown at 127.

In the embodiments illustrated in Figures 11 and 12, it would be of great convenience if the upstanding webs can be folded so that they lie flat against a surface of the lower plate in order to facilitate shipping of a larger number of the plates in a smaller container. Folding of the web is readily accomplished by providing the web with a hinge which allows such folding during shipment and which can be placed in an upright position during assembly of the upper plate to the lower plate.

In Figure 13 there is depicted a schematic partially cutaway representation of a roof in accordance with the present invention generally designated by the reference numeral 30. The roof 30 comprises a peripheral parapet 31, a roof deck 32, a plurality of thermal insulating panels 33 and a plurality of half panels 33a. The panels 33 and 33a are arranged with the parapet 31 on the roof deck 32 in such a manner that joints between panels in their minor dimension are staggered. The panels 33 and 33a are maintained in fixed relationship to each other by means of retainers 20b which have a configuration generally as that depicted in Figures 1-3. A generally water permeable light resistant layer 35, such as gravel, is depicted

above the panels 33 and 33a. A roof structure such as the roof 30 of Figure 4 is readily prepared by installing the panels 33, for example, the five full panels 33 depicted at the left side of Figure 4. At the top of Figure 4 and adjacent the left hand row of panels 33 is installed a retainer 20b fixed into position on adjacent panels 33 and 33a. A panel 33 is then abutted to the panels 33 of the left hand row and 33a adjacent thereto, and the corner thereof is slid into the retainer progressing downwardly to form a second row. The retainer 20b is fixed into position to engage adjacent panels 33 and an additional panel 33 is installed, the procedure being repeated until the entire roof area is covered. Due to the light weight of most thermal insulating panels, such as, for example extruded polystyrene foam having a density of about two pounds per cubic foot, panels such as the panel 33a in the second row from the left are readily installed by raising the adjacent panels slightly to clear the parapet 31, installing the panel and lowering the insulation assembly to the roof deck. Optionally, insulating panels such as panels 33 and 33a may be adhered to the roof deck or simply joined together by means of retainers 20b without adhering to the roof deck. In the event that ponding should occur at some period of time during the life of the roof, the non-adhered panels can float; and, not being adhered to the water permeable membrane, provide no force which tends to delaminate or place other undesired stress on the water impermeable membrane.

Figure 14 is a fractional schematic representation of a cutaway view of an alternate roof construction in accordance with the present invention generally designated by the reference numeral 140. The roof

construction comprises roof deck 141 having disposed thereon a water impermeable membrane 142 and a plurality of generally rectangular thermal insulating elements designated by the reference numeral 143. The insulating elements have their corners adjacent to each other. The adjacent corners are in engagement with a retainer such as retainer 80 of Figure 8, for example, with the retainer preventing relative movement between adjacent panels 143.

Panel retainers in accordance with the present invention are readily prepared from a variety of materials. Such materials may be materials such as stainless steel, galvanized steel, enameled black iron, painted black iron, tin plate and the like. The choice of the particular metal and particular finish will depend upon the environmental conditions. In a noncorrosive dry atmosphere, low cost sheet steel or iron is readily employed. For a more corrosive atmosphere, stainless steel is desirable. Webs separating the planar elements may be welded, spot welded, brazed, or the like. Usually thermal insulating panels employed on flat roofs are sufficiently deformable that relatively little physical effort is required to force a retaining means into a desired position, even if riveted construction is employed on the configuration of web 25 and 26 as depicted in Figure 3. Alternatively, such retainers may be prepared from synthetic resinous thermoplastic materials by injection molding, the choice of the particular material being dependent upon the particular environmental conditions. Such materials may range from polycarbonate resins to polystyrene resins, so-called nylon resins or polyolefin resins, such as

polyethylene, polypropylene, and the like. The choice of the particular material being primarily based on the environment in which it is to be used. Such resins advantageously may be employed alone or incorporating fillers such as calcium carbonate, carbon black, and the like. If maximum dimensional stability is required, thermosetting resins such as phenolic resins, furfuryl alcohol resins and the like may be utilized. Roofs prepared in accordance with the present invention employing retainers in accordance with the present invention exhibit highly desirable stability under windy and rainy conditions.

When employing cellular synthetic resinous insulating panels for roof structures in accordance with the present invention, in order to facilitate assembly of the panels and retainers, it is desirable in many instances to provide retainers which have rounded corners and edges or chamfered edges to thereby prevent tearing or penetration of the foam panel during assembly.

As is apparent from the foregoing specification, the present invention is susceptible of being embodied with various alterations and modifications which may differ particularly from those that have been described in the preceding specification and description. For this reason, it is to be appreciated that all of the foregoing embodiments are intended to be merely illustrative and is not to be construed or interpreted as being restrictive or otherwise limiting of the present invention, excepting as it is set forth and defined in the hereto-appended claims.

CLAIMS

1. A roof insulating element retaining device, said device comprising a first generally planar member, a second generally planar member in spaced parallel relationship to the first planar member; first and second connecting webs disposed between and generally normal to planes of the generally planar members, the first and second webs being disposed generally normal to each other, said retaining device being adapted to engage at least two corners of adjacent thermally insulating elements and at least a portion of a third insulating element.

2. The retaining device of Claim 1 wherein the planar members have a generally polygonal configuration.

3. The retaining device of Claim 1 wherein the planar members have a generally triangular configuration and the projected planes of the first and second webs intersect at a location within the planar members.

4. The retaining device of Claim 1 wherein the planar members have a generally triangular configuration and the projected planes of the web intersect outside of the planar members.

5. The retaining device of Claim 1 wherein the planar members are generally circular.

6. The retaining device of Claim 1 wherein the planar members are generally of an L-shaped configuration.

7. The retaining device of any one of the preceding Claims wherein the planar members define a generally centrally disposed opening.

8. The retaining device of any one of the preceding Claims wherein the edges and corners of the planar members are generally rounded.

9. The retaining device of any one of the preceding Claims wherein the first planar member is provided with at least one slot and the second planar member with at least one upstanding web which is adapted to extend through the slot in the first planar member to adjustably position the first planar member at a spaced, predetermined distance from the second planar member, and means for securing the first planar member at said predetermined distance with respect to said second planar member.

10. The retained device of Claim 9 wherein said securing means is at least one tab portion adjacent an end of the upstanding web which tab portion is adapted to be bent in a direction coplanar to the plane of the first planar member.

11. The retaining device of Claim 9 wherein said securing means comprises a pair of tab portions

which are adapted to be bent in opposite directions from each other and in directions coplanar to the plane of the first planar member.

12. The retaining device of any one of Claims 9 to 11 wherein the webs are hingedly mounted to said second planar member.

13. A roof comprising a roof deck, a layer of thermally insulating panels, the insulating panels being joined to one another by means of a plurality of the insulating element retaining devices of any one of the preceding Claims.

14. A method of preparing a built-up roof, comprising the steps of applying and affixing to a roof deck a water impermeable membrane, disposing on the water impermeable membrane a plurality of closed cell water impermeable thermally insulating members defining fissures between adjacent members, affixing said members to each other by means of the retaining device of any one of Claims 1 to 12.

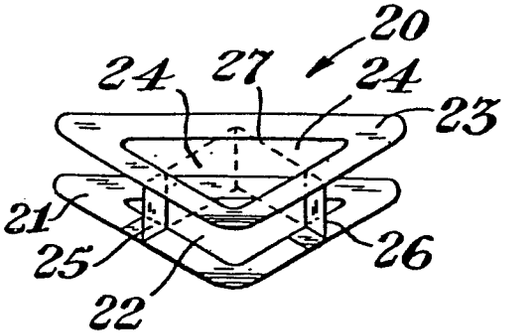


Fig. 1

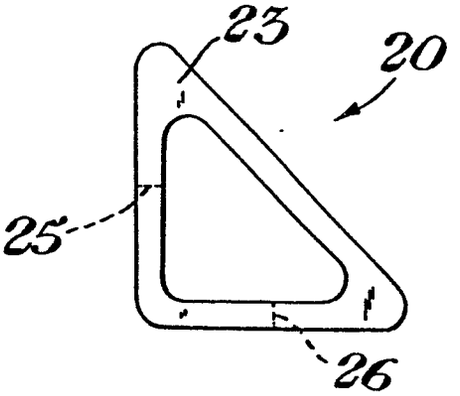


Fig. 2

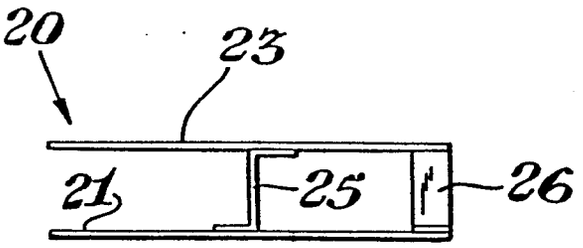


Fig. 3

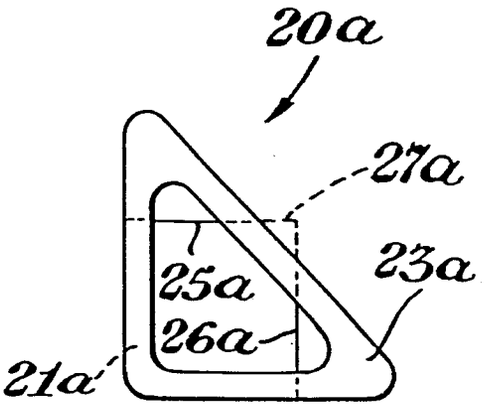


Fig. 3A

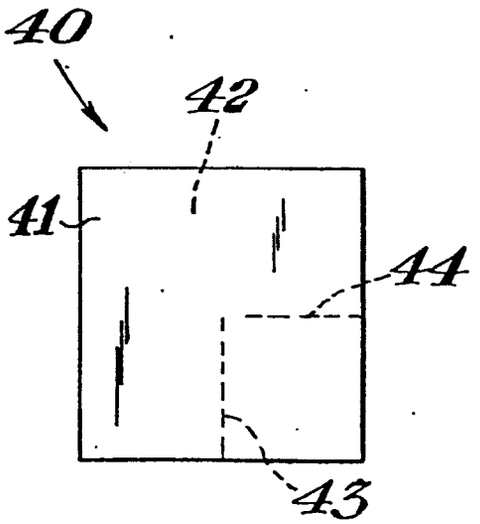


Fig. 4

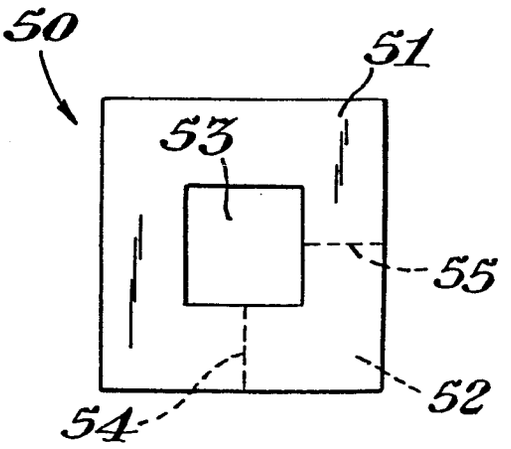


Fig. 5

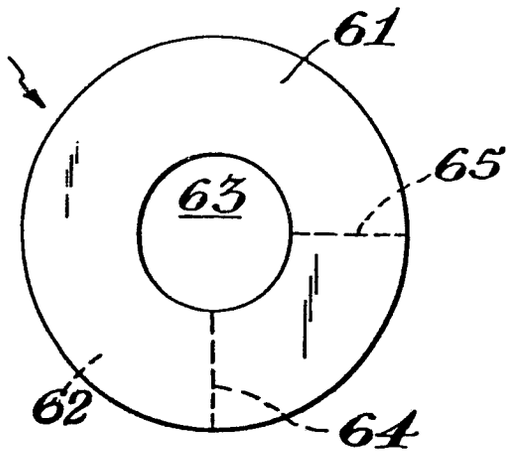


Fig. 6

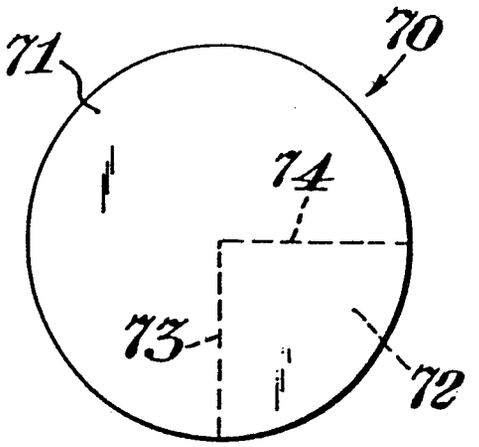


Fig. 7

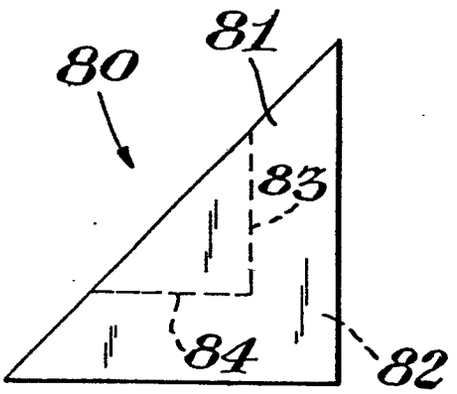


Fig. 8

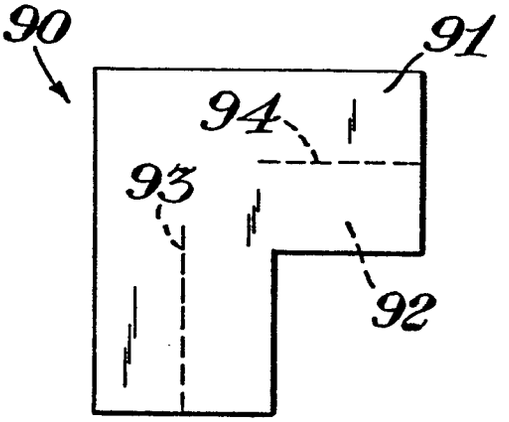


Fig. 9

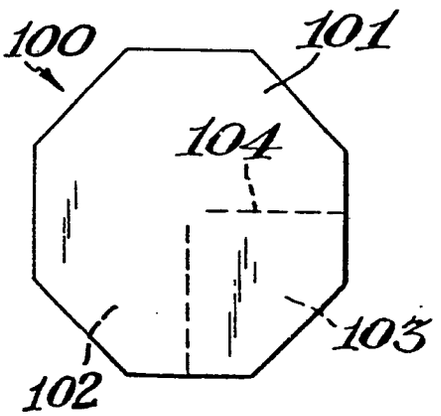


Fig. 10

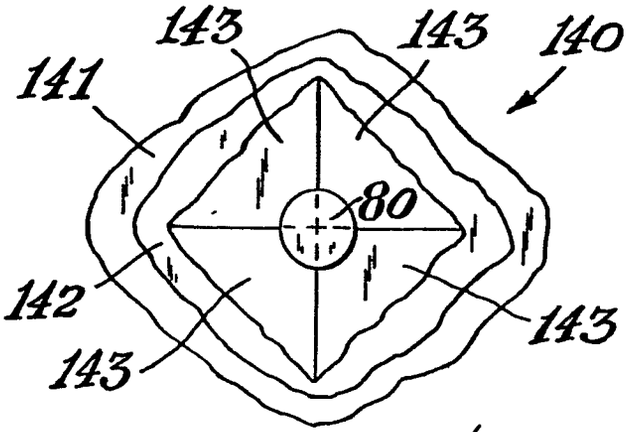
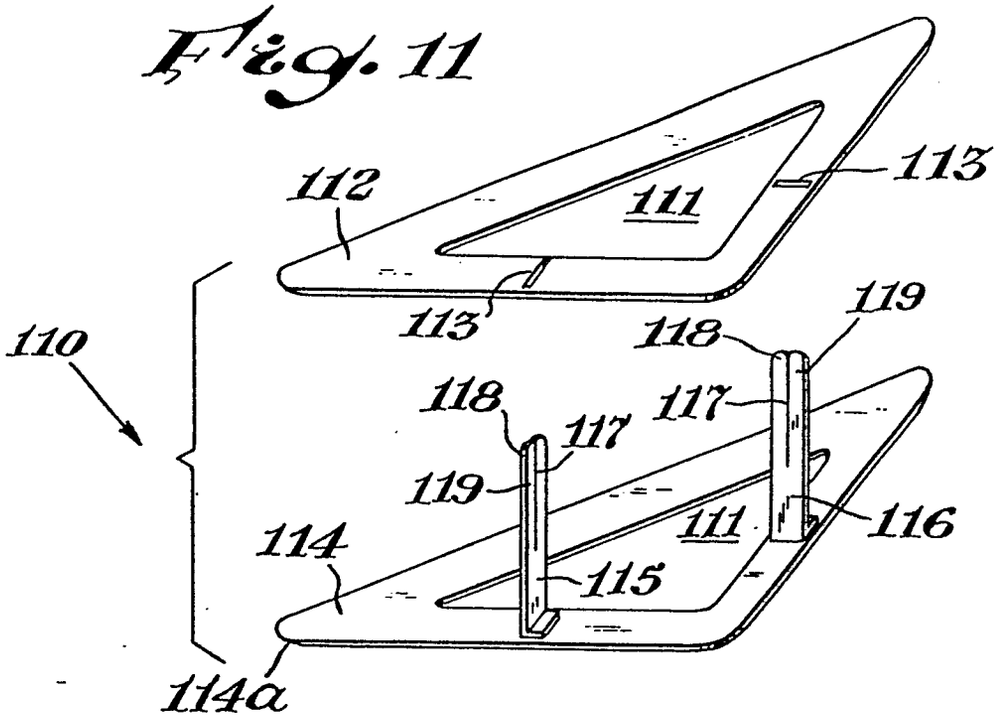


Fig. 14

Fig. 11



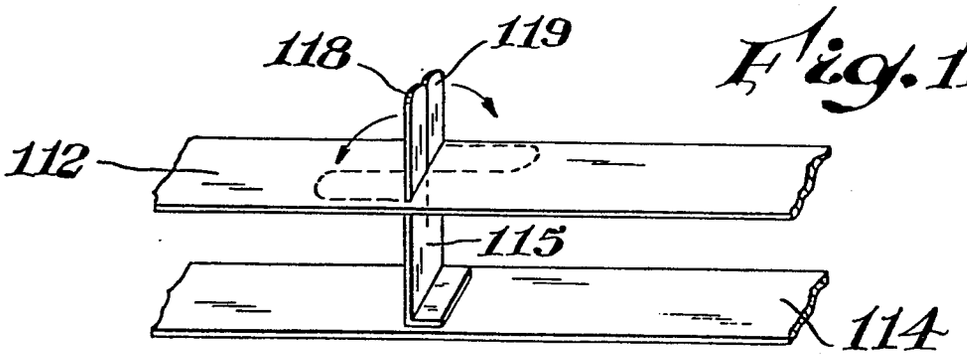


Fig. 11A

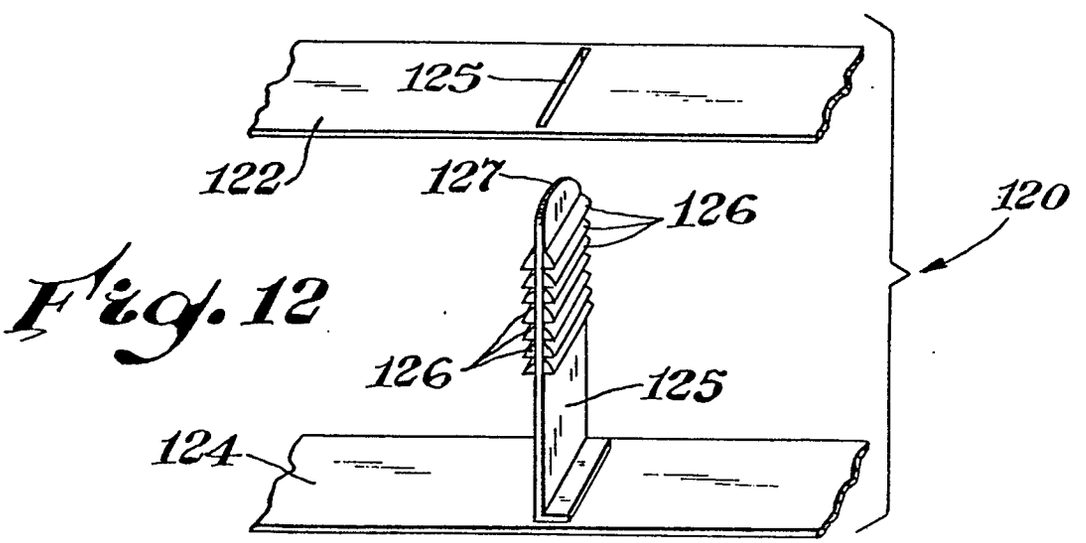


Fig. 12

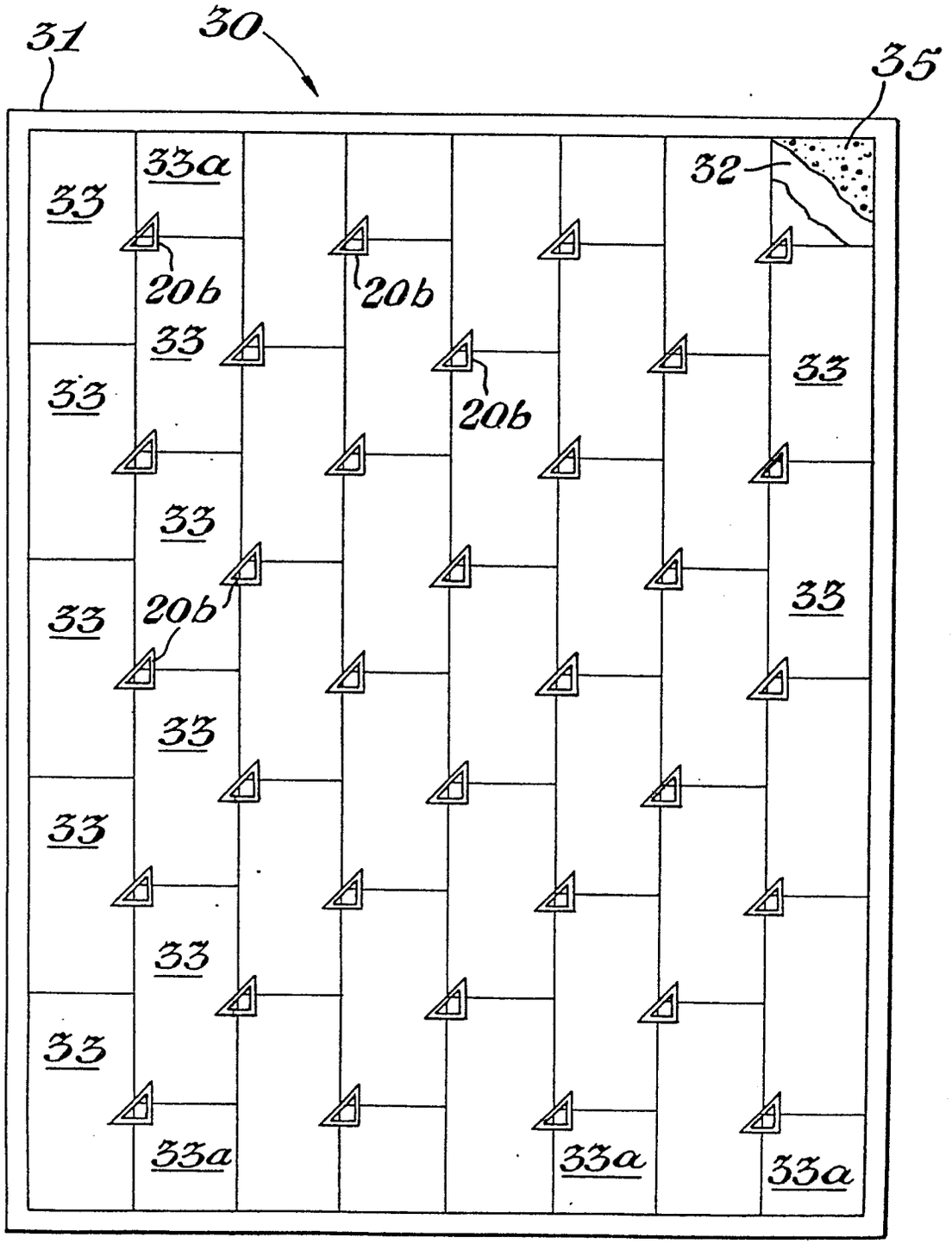

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Fig. 13