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(54) INSULATED PITCHED ROOF SYSTEM AND METHOD OF INSTALLING SAME

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(57) **ABSTRACT**

The present invention is an insulated pitched roof system for a sloped deck in which an insulating component is adhered to the sloped deck and the roof tiles are adhered to the insulating component with an adhesive, preferably a polymer adhesive. The insulating component includes a board or sheet material which is adhered to the roof deck. The insulating component is preferably adhered directly to the roof deck with a polymer adhesive. The insulating component preferably includes interlocking sides for forming a water tight connection between adjacently joined insulating components. Additionally, the insulating components include an end lap portion to form an overlapping portion between adjacent rows of insulating components. In a preferred embodiment, the overlapping portion is adhered together to form a unitary insulative and waterproof layer.

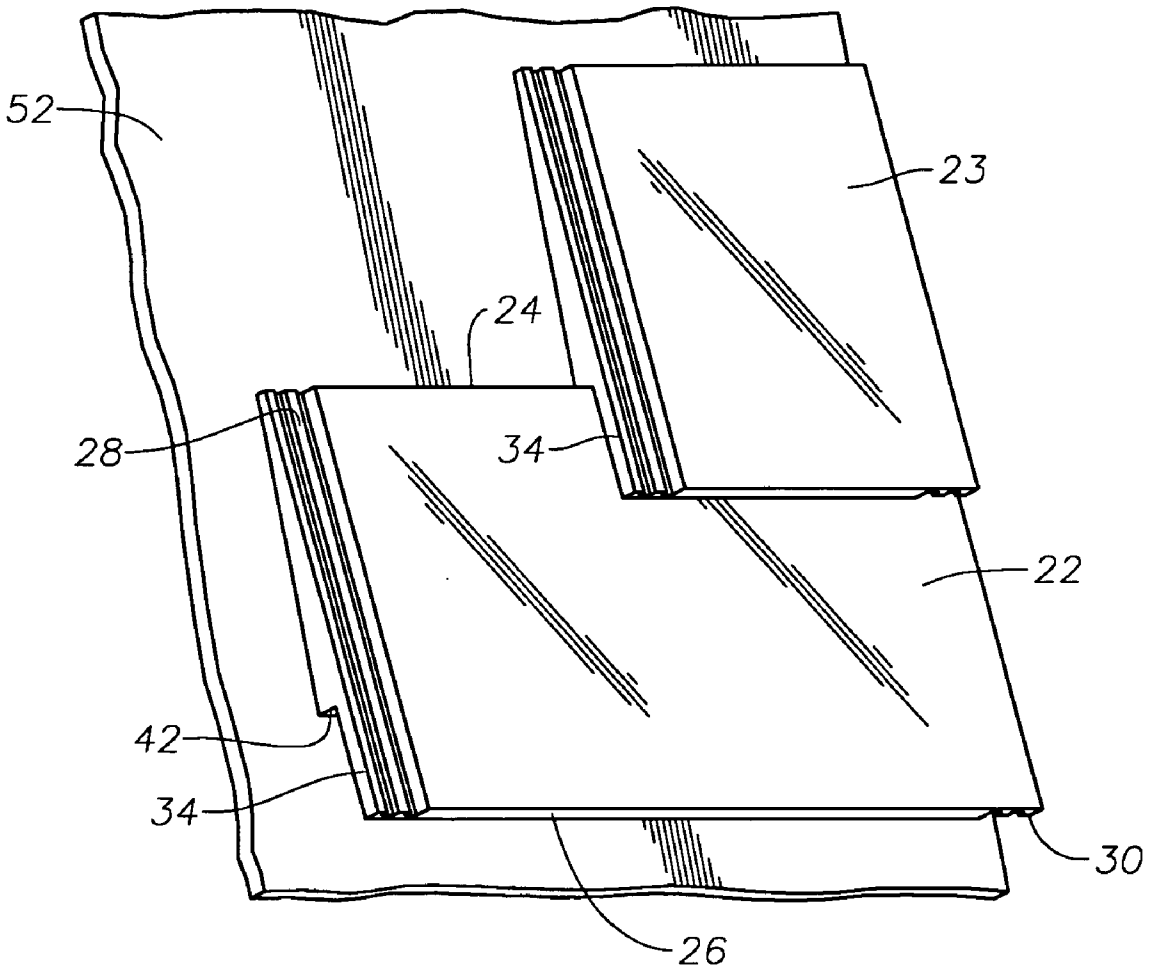


Fig. 1

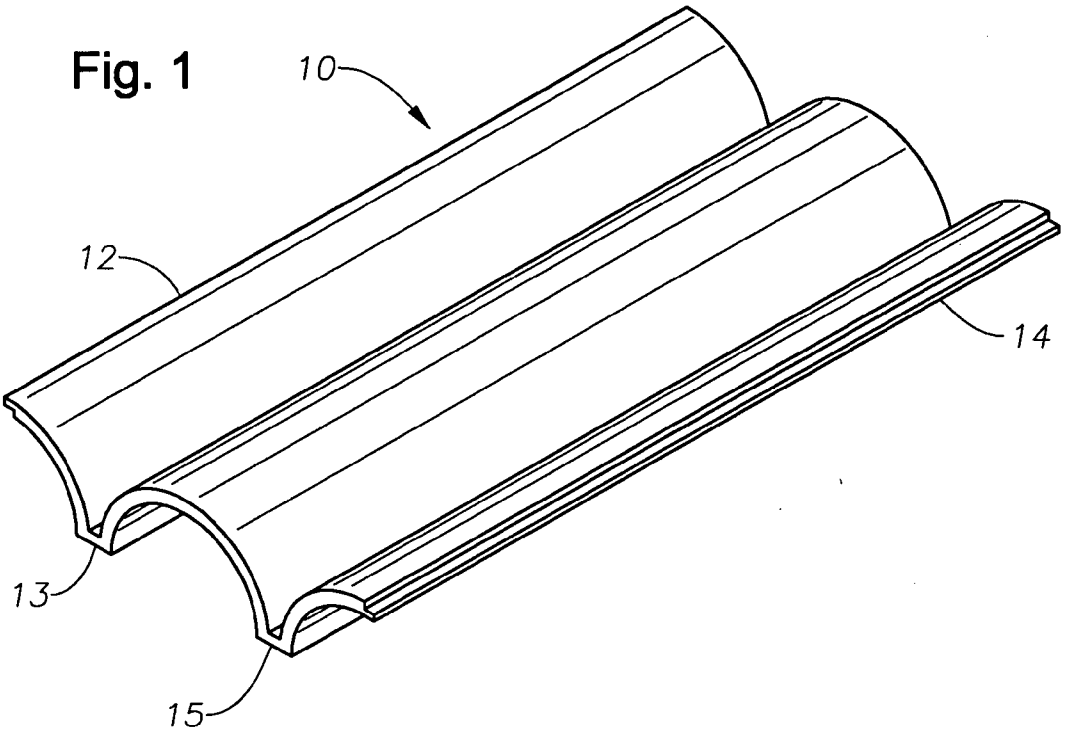
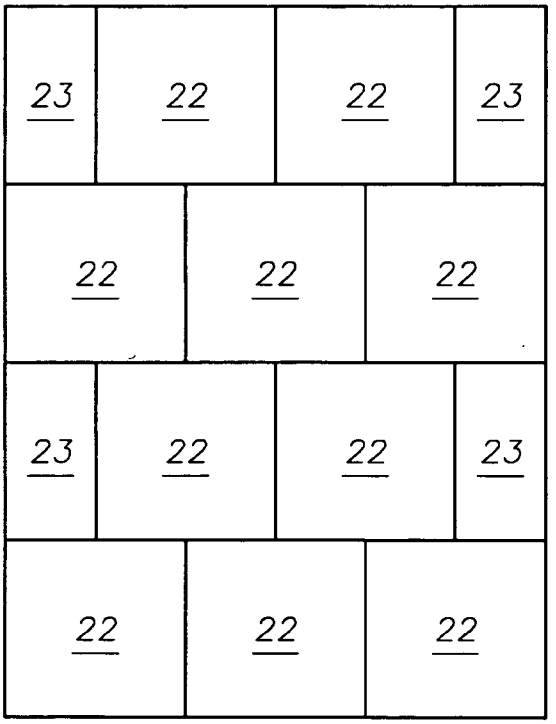


Fig. 4



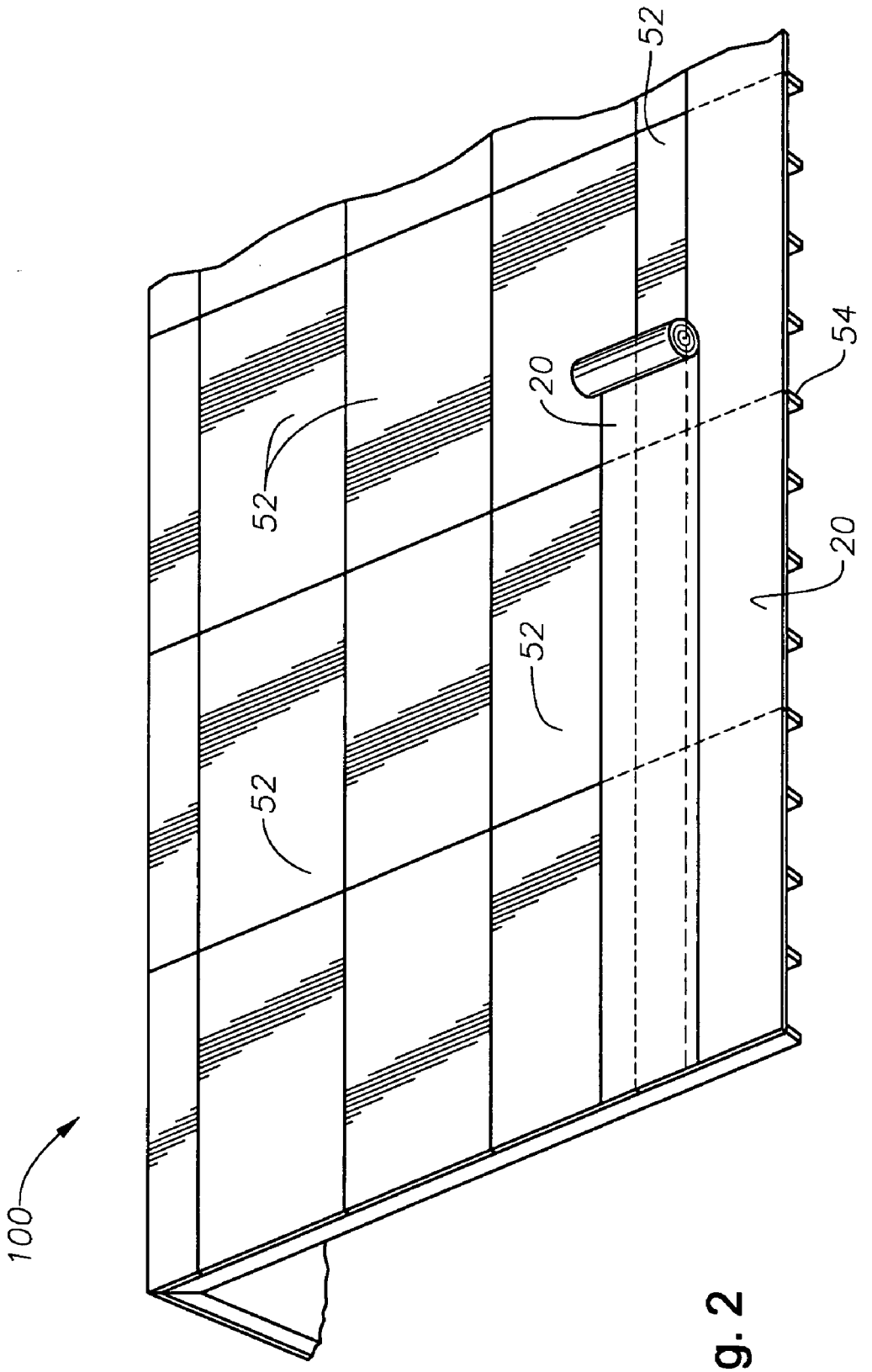
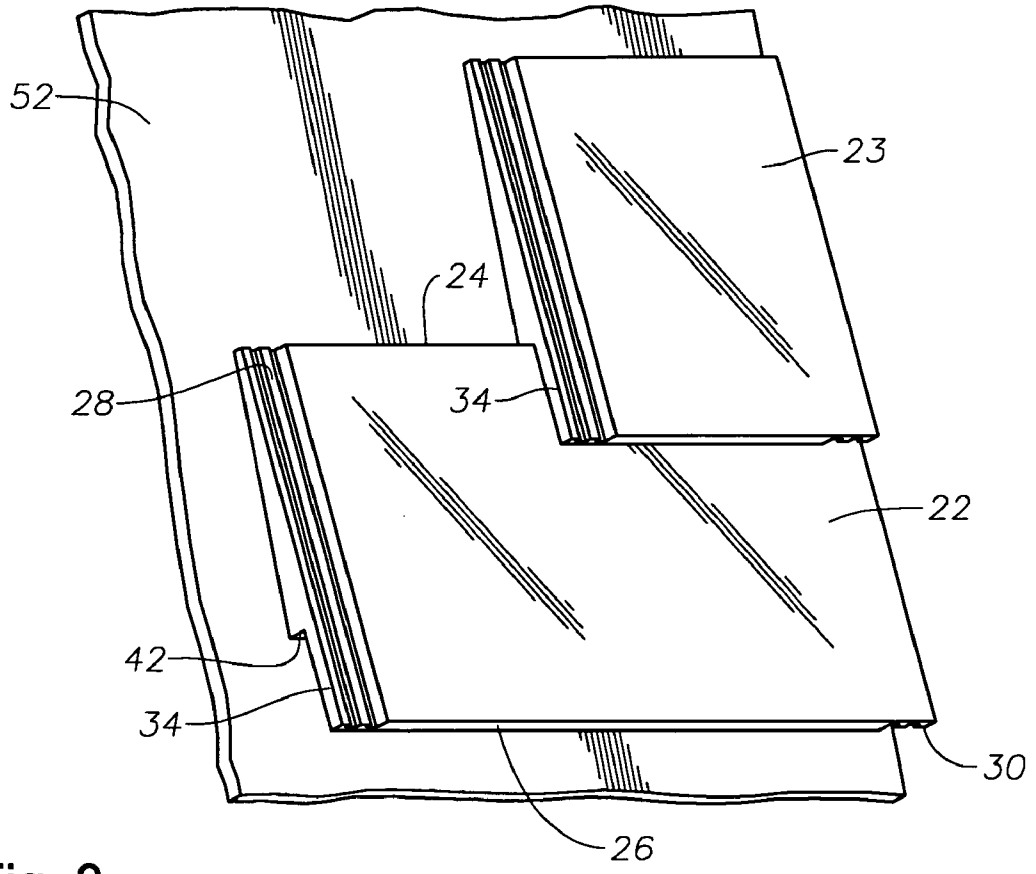


Fig. 2


52
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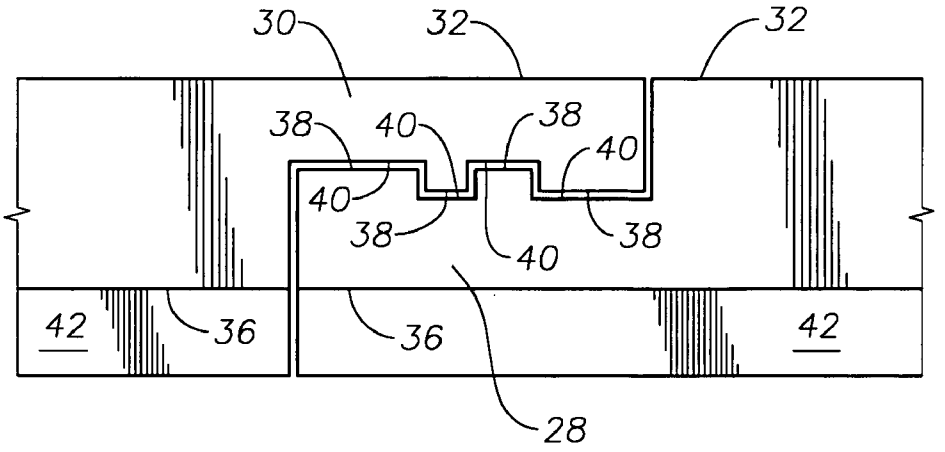
26

Fig. 3

Fig. 5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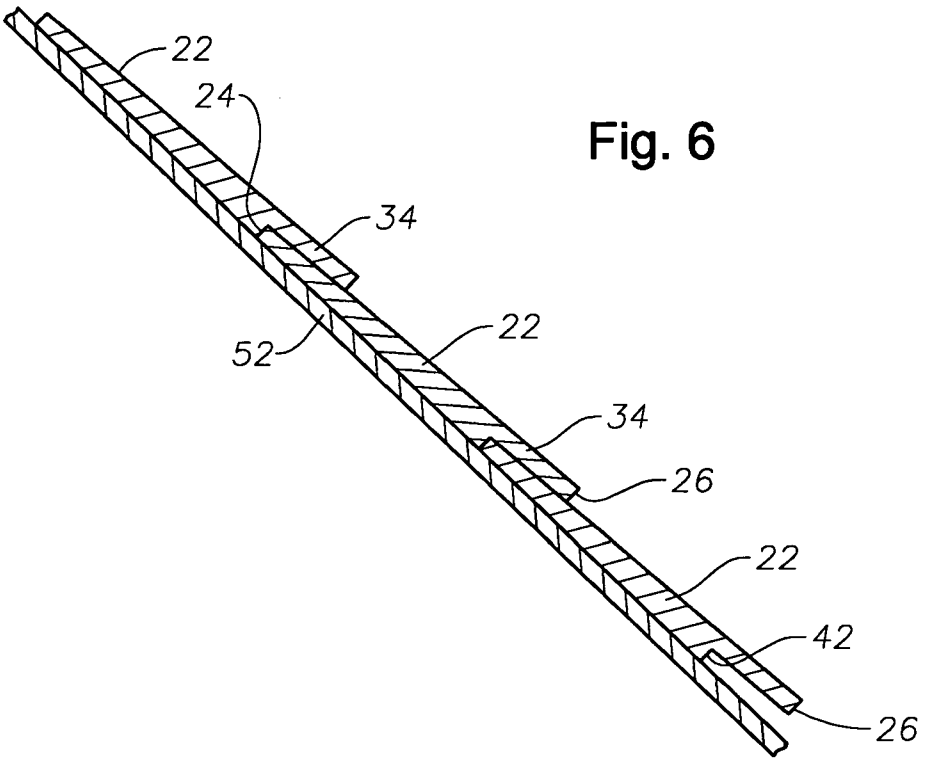

Fig. 6

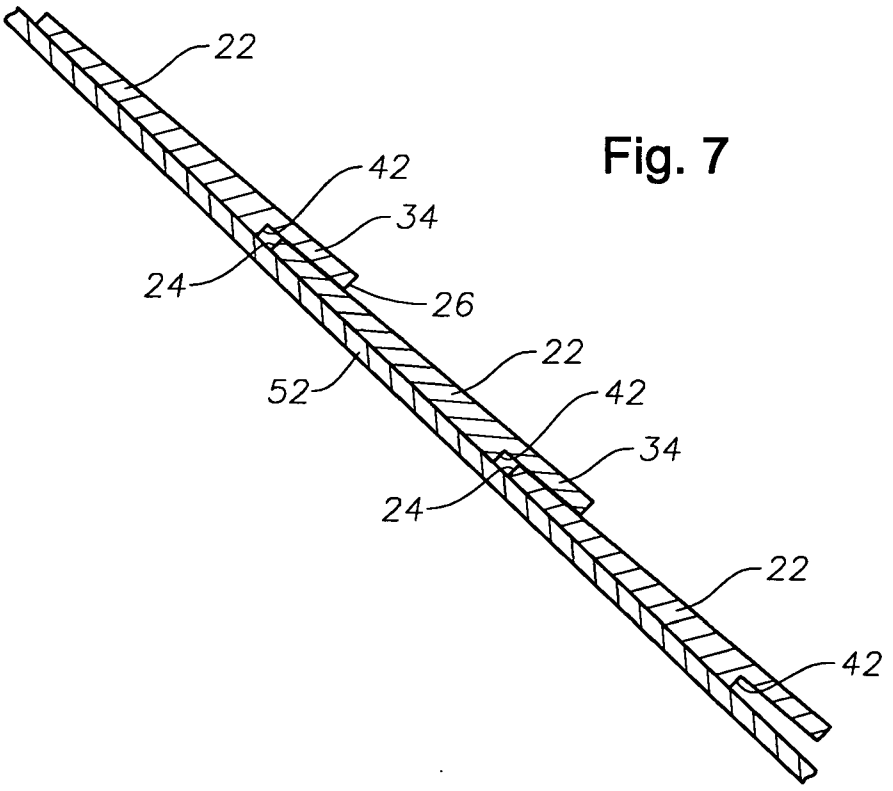

Fig. 7

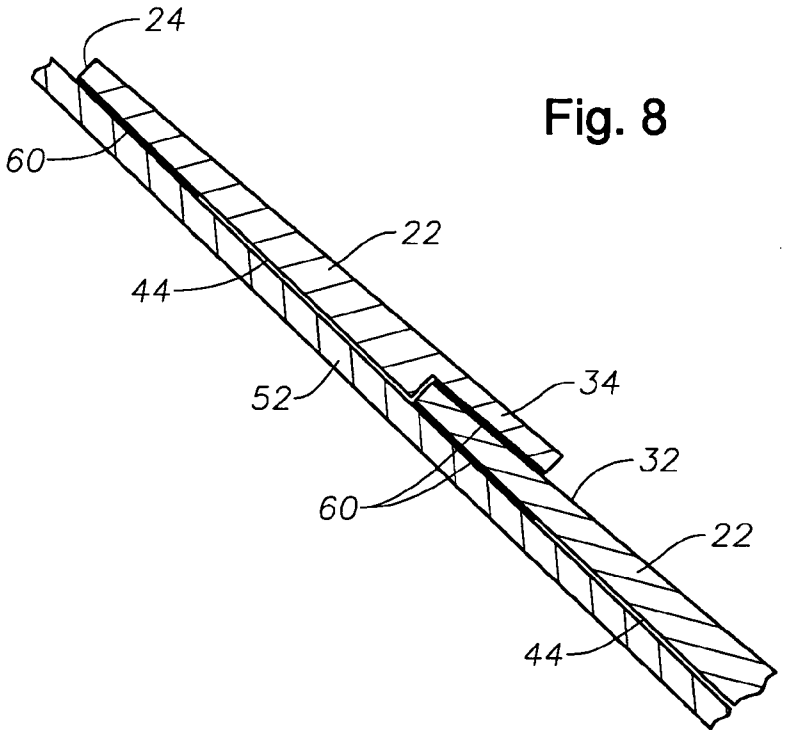
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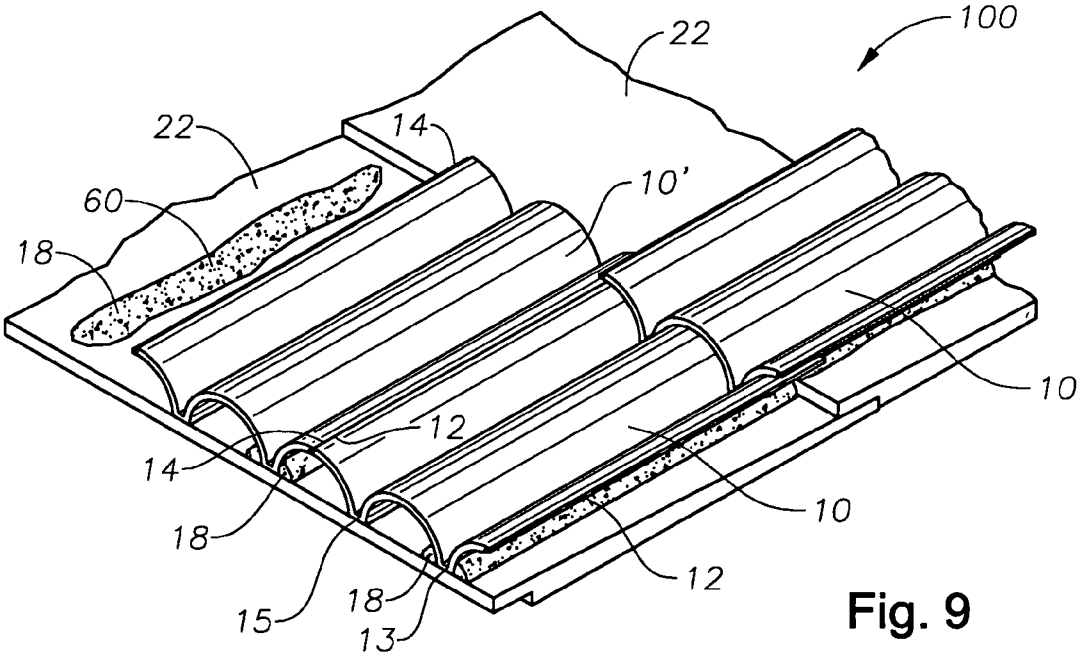
Fig. 8


100
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13

Fig. 9

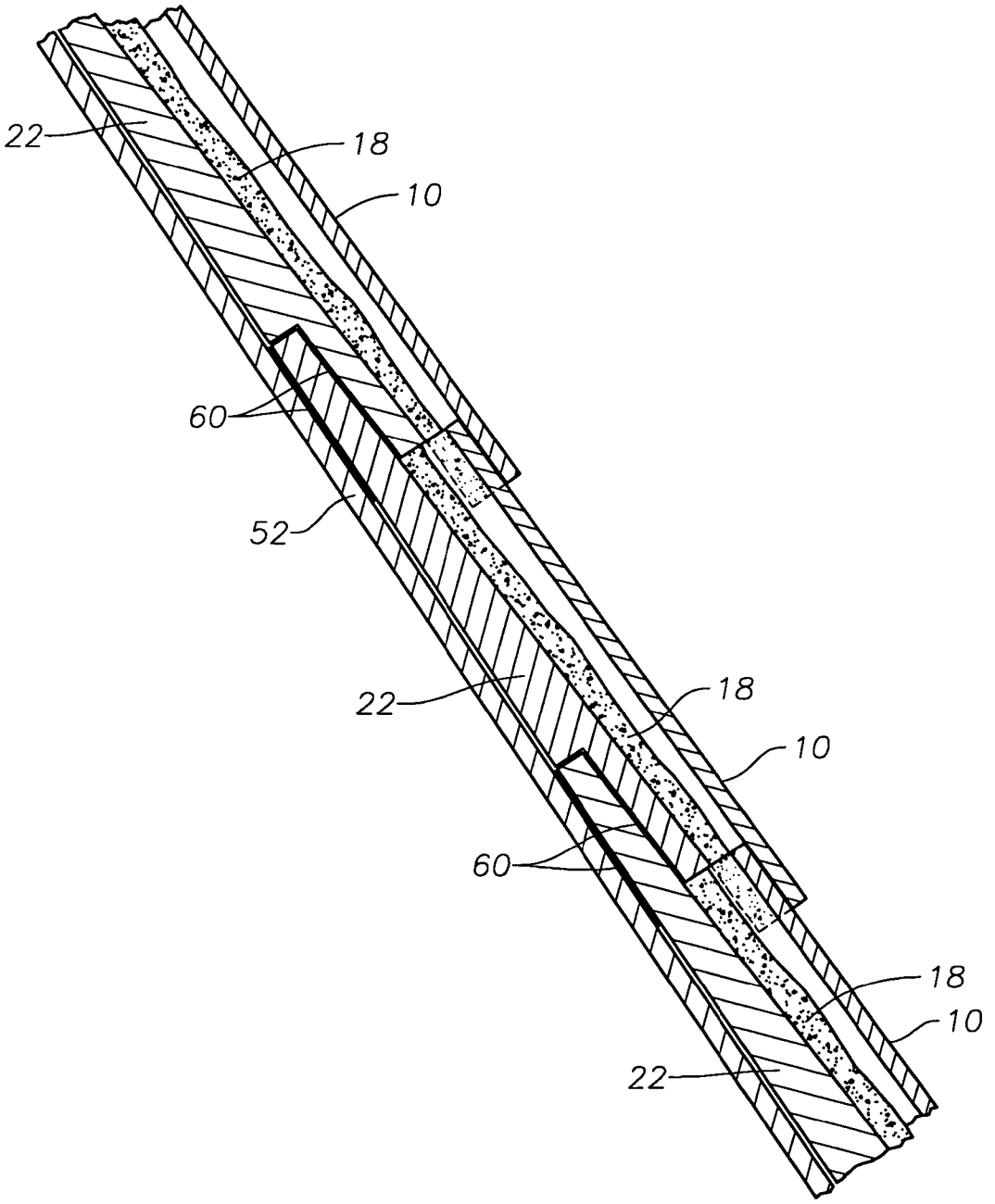

Fig. 10

INSULATED PITCHED ROOF SYSTEM AND METHOD OF INSTALLING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Applicants have pending related U.S. application Ser. No. 10/294,959, published May 15, 2003. Applicants hereby incorporate by reference U.S. patent application Ser. No. 10/294,959 in its entirety.

STATEMENTS REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable.

REFERENCE TO A MICROFICHE APPENDIX

[0003] Not Applicable.

BACKGROUND OF THE INVENTION

[0004] 1. Field of the Invention

[0005] The present invention relates to a pitched roof system and method, and particularly to a system and method for insulating the pitched roof and attaching the roofing components.

[0006] 2. Description of the Related Art

[0007] There are two basic types of roofs: flat and pitched. Pitched roofs come in a few basic styles, all of which are relevant to the present invention. A duo-pitched roof has two sloping sides joined along the top with end vertical walls called a gable end. This is probably the most common form of pitched roof. If the end of the roof is also sloping it is termed hipped. If two sections of roof meet at an angle, such as a right angle, the junction between the two roof sections is termed a valley.

[0008] Various roof components are used as roof coverings on pitched roof decks. One example of roof component is a roof tile. Roof tiles are extremely durable and provide significant aesthetic and decorative effects to the structures to which they are applied. Roof components or coverings as described herein may be made of cementitious materials and also brick, stone, clay, plastic, wood, metal, rubber or bituminous materials.

[0009] A typical pitched roof system includes sheets of wood, typically plywood or decking material, nailed to the truss rafters to form a pitched roof deck. Other pitched roof decks may be made with materials such as steel or concrete. Typically, the pitched roof deck is overlaid with a roof substrate made of a waterproofing material. Typically, the waterproofing material forming the roof substrate is a roll goods membrane or underlayment comprising one or more plies of asphaltic or modified bitumen impregnated felt attached to the pitched roof deck. The felt is typically attached to the pitched roof deck by nails and/or adhesive. Felt is generally made of wood pulp and rag or of asbestos, polyester or glass fibers. Self-adhering membranes, commonly referred to as "peel and stick," may also be used. These membranes are generally modified bitumen impregnated fiberglass or polyester fibers. Some pitched roof systems having steel or concrete decks do not require the use of a waterproof membrane or coating.

[0010] Roof components are primarily secured to the pitched roof deck with mechanical fasteners. Nails are the primary mechanical fasteners for securing roof components to a wood deck. Typically, tile roof components are secured with nails, inserted through holes in the tile roof component, driven into and through the roof substrate and wood deck. Mortar is sometimes used in conjunction with nails to provide holding force of the tile roof component to the roof deck. In either case, it is undesirable to drive numerous holes through the roof substrate and wood deck since these nail holes provide a potential leak path in the pitched roof system. High wind loading conditions also affect the roof components secured with nails. In areas near salt water the effectiveness of nails is diminished over time due to corrosion of the nails. Additionally, nails get loose over a period of time. Some decks, such as concrete or steel decks, cannot be nailed into. Non-nailable decks (concrete, steel, etc.) use a wire tie or other cumbersome and expensive system to fasten the roof components to the pitched roof deck.

[0011] As stated above, mortar or similar binders are often used as a secondary fastener between tile roof components and the roof substrate. Using mortar is a slow procedure and labor intensive as the mortar must first be prepared, typically at ground level, in buckets which must then be raised to the pitched roof deck, and then the mortar is applied to the roof substrate. The mortar adds unnecessary weight to the roof system. The set-up time of the mortar increases the time required to form the bond between the tile roof component and the roof substrate. The installed tile roof components should not be disturbed until the mortar has set-up as movement of the tile roof component affects the bond. Furthermore, the strength of the completed bond between the tile roof component and the roof substrate can be unsatisfactory. Typically, an approximate 60-pound tensile load applied transversely to the tile roof component will break the mortar bond between the tile roof component and the roof substrate. During high wind loading conditions, such as that experienced during a hurricane or a tornado, the tile roof components frequently release from the roof structure and become life threatening, flying projectiles. During such events, the tile roof components are widely strewn about and scattered throughout the area. The flying tile roof components result in additional danger during these devastating events and further increase the tremendous burden of clean up after these catastrophic events.

[0012] Assignee's U.S. Pat. No. 5,362,342 discloses a method of bonding tile roof components to a roof substrate utilizing polyurethane foam as the bonding medium. The method includes the step of applying under low pressure a stream of two component foamable liquid polyurethane on a prepared roof substrate. The foamable liquid polyurethane has a density preferably in the range of one and one-half to two pounds per cubic foot and a reactivity period in the range of one and one-half to four minutes. The foamable liquid polyurethane is preferably applied at a rate in the range of two to three pounds per minute. The tile roof component is placed into contact with the foamable liquid polyurethane during the reactivity period of the foamable liquid polyurethane. The bond between the tile roof components and the roof substrate with the polyurethane foam is several times increased over the mortar and mechanical bonds.

[0013] It is desirable to provide an energy efficient pitched roof system at a reasonable cost. Thus, it is desirable to have a pitched roof system that provides insulation to reduce energy consumption. It is also desirable in a pitched roof system to minimize the difficulty of precisely aligning and installing the rows of roof components to assure the most aesthetically pleasing appearance of the installed roof system. Furthermore, it is desirable that the method of installation be a simple operation, non-labor intensive, economical and not require excessive installation time. Additionally, the pitched roof system should withstand the long-term effects of temperature and climatic variations experienced by the pitched roof system under normal circumstances.

BRIEF SUMMARY OF THE INVENTION

[0014] One embodiment of the present invention includes an insulated pitched roof system and method of installation for a sloped or pitched roof deck of wood, metal, concrete or other material. The pitched roof system according to an embodiment of the present invention is energy efficient and is particularly suited to a roof having a 2:12 pitch or greater.

[0015] An insulating component according to an embodiment of the present invention includes a board or sheet material which is adhered to the roof deck. The insulating component is preferably adhered directly to the roof deck with a polymer adhesive. The roof components are preferably adhered to an upper surface of the insulating component with a polymer adhesive.

[0016] The insulating component preferably includes interlocking sides for forming a water tight connection between adjacently joined insulating components. Additionally, the insulating components include an end lap portion to form an overlapping portion between adjacent rows of insulating components. In a preferred embodiment, the overlapping portion is adhered together to form a unitary insulative and waterproof layer.

[0017] The method of installing the pitched roof system according to an embodiment of the present invention is a simple operation, non-labor intensive, economical and does not require excessive installation time. The pitched roof system will withstand the long-term effects of temperature variations and climatic conditions experienced by the pitched roof system under normal circumstances.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0018] The objects, advantages, and features of the invention will become more apparent by reference to the drawings which are appended hereto and wherein like numerals indicate like parts and wherein an illustrated embodiment of the invention is shown, in which:

[0019] **FIG. 1** is a perspective view of a typical roof tile that can be used with an embodiment of the pitched roof system of the present invention;

[0020] **FIG. 2** is a perspective view of a pitched roof deck having a roof substrate applied to the roof deck;

[0021] **FIG. 3** is a perspective view of a portion of the pitched roof deck having insulating components installed on the roof deck;

[0022] **FIG. 4** is a view of a pitched roof deck having staggered, overlapping insulating components installed on the roof deck;

[0023] **FIG. 5** is an end view of an embodiment of the present invention showing an interlocking connection between adjacent insulating components;

[0024] **FIG. 6** is a side view of adjacent rows of insulating components installed on the roof deck with the rows of insulating components tightly arranged with no gap therebetween;

[0025] **FIG. 7** is a side view of adjacent rows of insulating components installed on the roof deck with the rows of insulating components arranged with a gap therebetween;

[0026] **FIG. 8** is a side view, similar to **FIG. 6**, showing a portion of two adjacent rows of insulating components installed on the roof deck with adhesive;

[0027] **FIG. 9** is a perspective view of a portion of the pitched roof system showing an upper row of roof tiles overlapping a lower row of roof tiles; and

[0028] **FIG. 10** is a side view similar to **FIG. 8**, in section, showing the pitched roof system with the roof tiles installed on the insulating components.

DETAILED DESCRIPTION OF THE INVENTION

[0029] The insulated pitched roof system and method of installing same, generally designated as **100**, will now be described in greater detail with specific reference to the drawings. Referring to **FIG. 1**, the pitched roof system **100** includes a roof component, designated generally as **10**. The roof component **10** shown in perspective view in **FIG. 1** is known as a semi-circular roof tile. It is to be understood that the system and method of the present invention **100** is not limited to semi-circular roof tiles. Rather, the system and method **100** can include roof components **10** of other types and configurations. For example, flat roof tiles and reverse curve roof tiles are just a few of the other types that can be used with the system and method **100**. Typically, the tile components **10** are made from cementitious or clay materials. It is also to be understood that the system and method of the present invention **100** is not limited to clay or cementitious roof tiles **10** but is also applicable to roof components **10** made from other materials including, but not limited to, brick, stone, plastic, wood, rubber, or bituminous materials. Thus, it is to be understood that the roof components **10** can also include expanded metal, fiber cement and asphalt shingles.

[0030] As shown in **FIGS. 1 and 9**, the semi-circular tile roof component **10** typically includes an interlocking connection at the first and second longitudinal edges **12** and **14**, respectively, of the tile roof component **10**. Referring to **FIG. 9**, the second edge **14** of the first tile roof component **10** mates with the first edge **12** of an adjoining second tile roof component **10'**. This type of interlocking connection for tile roof components **10** is well known in the art. The tile roof component **10** as shown in **FIG. 1** includes a first pan portion **13** and a second pan portion **15**. Typically, the pan portions **13** and **15** extend the length of the tile roof component **10**. It is to be understood that the pan portions **13**

and **15** are part of the illustrated roof component **10**, but are not essential to the invention.

[**0031**] A pitched roof deck, generally designated as **50**, is shown in **FIG. 2**. Typically, the pitched roof deck **50** is comprised of sheets of plywood or decking material **52** nailed to a plurality of truss rafters **54** or installed to other structural members or structural supports. The decking material **52** is typically in 4-foot by 8-foot sheets. Although not shown, the sheets of decking material **52** are positioned end to end and side to side. Typically, a plurality of nails is driven through the decking material **52** into the truss rafters **54**. The truss rafters **54** are typically on 24-inch or 16-inch centers. A sheet of decking material **52** is thus nailed to approximately 5 or 7 truss rafters **54**. It is to be understood that several truss rafters **54** have been omitted for clarity in **FIG. 2**. It is also to be understood that the roof deck **50** may alternatively be constructed of concrete, metal or other material.

[**0032**] In one embodiment of the present invention, a roofing substrate **20** is applied and preferably bonded to the upper surface of the decking material **52** to form a waterproof barrier or coating. The roofing substrate **20** can be a felt, commonly used in the roofing industry. The felt is a rolled goods membrane that is fastened to the decking material **52**, typically with mechanical fasteners such as nails and/or bonded to the decking material **52** with, for example, tar or bitumen. The felt is typically applied along the length of the roof with an adjacent row of the felt overlapping the edge of the prior row of felt. The roofing substrate **20** protects against rain and moisture coming into contact with and passing through the pitched roof deck **50**. Preferably, no roofing substrate **20** is used in certain embodiments of the present invention.

[**0033**] Referring to **FIG. 3**, an insulating component **22** is shown in position on the pitched roof deck **50**. A half panel insulating component **23** is shown positioned above the full panel insulating component **22**. Although not required, the half panel component **23** or a portion of the full panel component **22** is preferably used to form offsetting panel seams as shown in **FIG. 4**.

[**0034**] The insulating components **22** and **23** include a panel head **24** on the side facing the ridge, a panel tail **26** on the side facing the eave, an end lap portion **34**, and preferably interlocking sides **28** and **30**. For ease of discussion, it is to be understood that reference to insulating components **22** also pertains to half panel insulating components **23** unless explicit reference is made to full panel insulating component **22**. Preferably, the insulating component **22** is made of rigid sheet material, such as polystyrene, polyurethane, polyisocyanurate or other similar material. The insulating components **22** are preferably sized for convenience of handling and with relation to the size of the roof components **10**. One size found to be preferable for a variety of tile components is approximately 21.5" in length (measured from panel head **24** to tail **26**) and 48" in width (measured from side **28** to side **30**) for reasons which will be explained below.

[**0035**] The thickness of the insulating component **22** can be varied to alter the "R" value of the system. The "R" value is a measure of resistance to heat flow through one or more materials. The "R" value is the reciprocal of thermal conductance which is defined as the heat flow through a given thickness of 1-ft square material with a 1° F. temperature differential. Preferably, the thickness of the panel head **24** is the same as the height of the shoulder **42**. In the preferred embodiment of the present invention the panel head thickness and shoulder height is approximately ¾%

[**0036**] **FIG. 5** illustrates the details of one embodiment of the interlocking side connection of two adjacent insulating panels **22**. In the preferred embodiment of the present invention, the interlocking side **28** of one insulating panel is adapted to mate with the interlocking side **30** of another insulating panel **22**. The interlocking connection prevents the ingress of water through the connection to the decking material **52** below. Referring to the embodiment shown in **FIG. 5**, the interlocking sides **28** and **30** are underlock and overlock sides, respectively, which mate to form a flush, planer upper surface **32**. Similarly, the mating interlocking sides **28** and **30** also form a flush, planer lower end lap surface **36**. Preferably, the interlocking sides **28** and **30** have one or more step portions **38** which provide a better waterproof joint connection. It is to be understood that the interlocking joint connection shown in the figures is merely representative of a preferred embodiment and is not intended to limit the scope of the invention to the joint connection shown. It is appreciated that numerous other configurations are known to those of skill in the art and may be used to join the insulating components.

[**0037**] Still referring to **FIG. 5**, the interlocking connection of the preferred embodiment will be described in greater detail. It is to be understood that the clearance between the mating parts has been exaggerated in **FIG. 5** to provide clarity. In the embodiment shown in **FIG. 5**, the step portions **38** are separated by groove portions **40**. As seen in **FIG. 5**, the step portions **38** of interlocking side **28** matingly correspond with opposing groove portions **40** of interlocking side **30**. Preferably, the thickness of the end lap portion **34** is approximately ⅞" with the step portion **38** having a thickness of ½" and the groove portion **40** having a thickness of ⅜" which results in the step portion **38** having a height of ⅛" greater than the groove portion **40**. Additionally, the width of the joint connection of the preferred embodiment is approximately 1½" with the wide step portions and groove portions having a width of ½" and the narrow step portions and groove portions having a width of ¼". Once again it is to be understood that this is merely a preferred embodiment and is not intended to limit the scope of the present invention to this preferred joint design.

[**0038**] Referring now to **FIGS. 6 and 7**, two different insulation component installation arrangements are shown. In **FIG. 6**, three rows of insulating components are shown installed in a "tight" configuration with no gap between the panel head **24** and the shoulder **42** of the adjacently positioned higher insulating component **22**. In the tight configuration, the entire length of the end lap portion **34** extends above the adjacent lower insulating component **22**. The insulating components **22** are installed in the tight configuration for use with smaller length roof tiles **10**. In **FIG. 7**, the insulating components **22** are shown installed in a "spaced" configuration in which a gap is formed between the panel head **24** and the shoulder **42** of the adjacently positioned higher insulating component **22**. The spaced configuration may be required with greater length roof tiles **10** for reasons which will be explained below. It is to be understood that this spaced configuration allows the same insulating com-

ponent **22** to be used with roof tiles **10** of different lengths. Preferably, the length of the end lap portion **34** is approximately 5" from the panel tail **26** to the shoulder **42**. In most instances, it is preferable that at least 3" of the end lap portion **34** overlaps the adjacent lower insulating component **22** in any configuration. The preferred minimum of 3" of overlap is due to the desire to prevent rain and moisture from traveling between the overlapping portions of the adjacent insulating components **22** and contacting the roof deck **52**. This preferred feature may be unnecessary in certain steeply pitched roof designs or areas of low rainfall.

[**0039**] Referring to **FIG. 8**, the insulating component **22** is attached to the roof decking material **52**, preferably with adhesive **60**. The insulating component **22** may be adhered at one or more locations of the bottom surface **44** to the decking material **52**. The bottom surface **44** of the insulating component **22** is preferably a substantially flat surface. The preferred embodiment of the present invention dispenses with the need for the roofing substrate **20** as the insulating components **22** provide the waterproofing integrity of the pitched roof system **100**. However, if a roofing substrate **20** is used, the insulating components **22** are adhered in the same manner to the roofing substrate **20**.

[**0040**] In a preferred embodiment of the present invention, the bottom surface **44** is adhered to the decking material **52** with a polymer adhesive **60**, preferably polyurethane, described in greater detail below. It is to be understood that the amount of adhesive **60** required to adhere the insulating sheet material **22** to the decking material **52** will depend upon the bonding strength of the materials and the environmental and/or load conditions to which the system is being designed. As shown in **FIG. 8**, the adhesive **60** is shown adhering along the portion near the head end **24** of the insulating component **22**. The adhesive may be placed to continuously adhere across the width of the bottom surface **44** at one or more locations. Alternatively, it is to be understood that the placement of the adhesive **60** may be discontinuous or placed to adhere substantially the entire bottom surface **44** to the decking material **52**. The adhesive **60** is preferably placed, typically by spraying, on the decking material **52** and the insulating component **22** is then brought into contact with the adhesive **60**. Alternatively, the adhesive could be placed on the insulating component **22** before placing the insulating component **22** in contact with the decking material **52**.

[**0041**] Still referring to **FIG. 8**, preferably adhesive **60** adheres the end lap portion **34** of the upper insulating component **22** to the upper surface **32** of the adjacent lower insulating component **22**. In addition to preventing any capillary action of water from passing between the overlapping portions, the placement of the adhesive **60** at the locations shown in **FIG. 8** optimizes the amount of adhesive used and bonds the rows of insulating components **22** together to form an integrated insulating and waterproofing layer.

[**0042**] As is apparent from the drawings, the insulating components **22** and **23** are installed beginning at the lower right corner of the pitched roof deck **50** This is due to the overlapping nature of the insulating components **22** and **23** and also because of the interlocking connection of the insulating components **22**, **23** shown in **FIGS. 3 and 5**. As previously indicated, the interlocking connections of the adjacent rows are preferably staggered by using a half panel insulating component **23** as shown in **FIG. 4**. A lower row of interconnected insulating components **22** are adhered to the roof deck **50** followed by adjacent overlapping upper rows. Alternatively, the roofing installer may prefer to install only a portion of the lower row and then portions of the upper rows to cover a portion of the roof.

[**0043**] It is also to be understood that the entire roof deck **50** may be covered with the insulating components **22** prior to the installation of the roof tiles **10** or the installer may choose to install the roof tiles **10** on the insulating components **22** prior to installing the insulating components **22** on the entire roof deck **50**.

[**0044**] The roof tiles **10** are preferably adhered to the upper surface **32** of the insulating components **22** with an adhesive, such as the polymer adhesive **60**. Preferably, the polymer adhesive **60** is a polyurethane described in greater detail below. A method of attaching the roof components **10** to the insulating component **22** and a typical polymer adhesive **60** are disclosed in assignee's U.S. Pat. No. 5,362,342, issued to Murray et al., which is incorporated by reference. However, it is to be understood that the present invention is not limited to the method and adhesive disclosed in U.S. Pat. No. 5,362,342.

[**0045**] One method of attaching the roof components **10** with the polymer adhesive **60** is shown in **FIGS. 9 and 10**. Referring to **FIG. 9**, the roof components **10** are installed in rows beginning along the lower edge of the roof. One or more pads or paddies **18** are located at or adjacent the position where the first pan portion **13** of the roof component **10** will be situated on the insulating component **22** adhered to the decking material **52**. The roof component **10** is then adhered to the insulating component **22**. Referring to **FIG. 9**, a worker places one or more paddies **18** of the polymer adhesive **60** on the insulating component **22** at a location at which the roof component **10'** is to be applied. The roof component **10'** is placed adjacent to the previously installed roof component **10** so that the first edge **12** of the second roof component **10'** overlaps and interlocks the second edge **14** of the first roof component **10**. The first pan portion **13** of the roof component **10** is positioned in and above the paddy or paddies **18** of polymer adhesive **60** during the reactivity period of the polymer adhesive **60**. Due to the interlocking connection of adjacent roof components **10** as shown in **FIG. 9**, the polymer adhesive **60** is not required beneath the second pan portion **15** of the roof component **10**. One or more paddies **18** beneath the second pan portion **15** may be used to obtain an even greater bond between the insulating component **22** and the roof component **10**, if desired. It is to be understood that the above described method may be preferred for the tile shape shown in the drawings although other amounts, arrangements or placement of adhesive **60** can be used. Further, it is to be understood that other tile shapes used with the present invention may require other arrangements and/or placement of the adhesive **60** to bond the roof component **10** to the insulating component **22**.

[**0046**] According to one embodiment of the present invention, the polymer adhesive **60** may be a foamable or a non-foamable one component or plural component polymer adhesive. Preferably, the polymer adhesive **60** is a plural component, liquid polyurethane foam. The significant

advantage of the plural component polyurethane foam is being able to walk on the installed roof components **10** shortly after the roof components **10** have been installed without affecting the bond between the roof component **10** and insulating component **22**. The reactivity period or rise time of the plural component liquid polyurethane foam **60** of the present invention is preferably about one-half to about ten minutes and most preferably about one and one-half to about four minutes. It is important that the roof component **10** be properly placed during the reactivity period to achieve the required bonding of the roof component **10** to the insulating component **22**. During the reactivity period, the liquid polyurethane foam **60** is an expanding foam, which will fill gaps and imperfections. The resulting foam provides excellent bonding between the roof component **10** and the insulating component **22** due to the adhesive properties of the urethane. It has been found that a reactivity period of less than about one-half minute makes it difficult to timely place the roof component **10** during the reactivity period.

[**0047**] The foamable liquid polyurethane **60** is preferably a froth foam. Froth foam chemistry is well known in the art of urethane foams. The froth foam may be formed by using blowing agents such as hydrogenated chlorofluorocarbon R22 (HCFC-R22), hydrogenated fluorocarbon 134A (HFC-134A), or chlorofluorocarbon R12 (CFC-R12) or hydrocarbons pentane and cyclohexane. Preferably, the froth foam **60** is formed by using the hydrogenated blowing agents HCFC-R22 or HFC-134A, and not CFC-R12 due to CFC-R12's reported deleterious effects to the earth's ozone layer.

[**0048**] Preferably, the froth foam **60** has a consistency similar to a foamy shaving cream. The froth foam is preferable over other types of foams because it can be neatly and accurately dispensed without blowing or overspraying onto other areas of the roof deck or onto the outer surface of adjacently installed roof components **10**. The preferred liquid polyurethane **60** with its shaving cream consistency does not run when placed onto a steeply pitched roof, but remains where it is installed on the insulating component **22**. This ensures that the adhesive bond will be formed at the appropriate locations of the roof component **10**. Additionally, the froth foam **60** begins expanding immediately upon application to the insulating component **22** and results in a firm bond with the underside of the roof component **10**.

[**0049**] The liquid polyurethane **60** preferably has a density of about one to about eight pounds per cubic foot. It may be desirable to minimize the density of the liquid polyurethane **60** to minimize the weight on the roof while still providing an excellent bonding of the roof component **10** to the insulating component **22**. It has been found to be most preferable to have a foam density of about one and one-half to about two pounds per cubic foot. The application rate of the liquid polyurethane **60** is preferably about one to about six pounds per minute and most preferably about two to about three pounds per minute.

[**0050**] Referring to **FIG. 9**, an upper roof component **10** of a second row is shown overlapping the lower row of roof components **10**. In **FIG. 10** a section view is taken of portions of three rows of roof components **10** installed on the insulating components **22**. While not shown, the first pan portion **13** may or may not rest on the insulating component **22** along its entire length. Rather, the first pan portion **13** at the ridge end of roof component **10** may be in contact or very near contact with the insulating component **22** while moving gradually away from the insulating component **22** at the eaves end where it overlaps the lower roof component **10**. The foamable liquid polyurethane **60** expands and fills the gaps between the insulating component **22** and the first pan portion **13**. The excess foam continues expanding and provides further bonding with adjacent surface areas of the roof component **10** as shown in **FIGS. 9 and 10**. A thin layer of foam may be present between the insulating component **22** and the first pan portion **13** at the highest end of the roof component **10** depending on the placement of the paddy or paddies **18**.

[**0051**] Referring to **FIG. 10**, the expanding foam **60** also provides a bond between the upper roof component **10** and the lower roof component **10** at the overlapping portion where the expanding foam can fill any gap between the two roof components **10**. This further enhances the overall bonding capacity of the roof components **10** to the insulating component **22**. Preferably, as shown in **FIG. 10**, there is substantial alignment of adhesive bonding from the decking material **52** to the insulating component **22** to the roof component **10** for optimal design. Furthermore, this alignment is preferably generally perpendicular to the slope of the roof. The alignment is shown in **FIG. 10** at the overlapping portions of the insulating components **22** and roof components **10**.

[**0052**] As shown in **FIGS. 9 and 10**, the panel tail **26** aids in ensuring that the roof tiles **10** are properly placed to provide a more pleasing aesthetic appearance. During installation the ridge end of the roof tile is placed to abut against the panel tail **26** which ensures the installation of straight rows of roof components **10**.

[**0053**] It is to be understood that the present invention is an insulated pitched roof system and method **100** that can be used on pitched roof decks **50** made of various materials, including but not limited to wood, metal and concrete. The system **100** according to an embodiment of the present invention includes an insulating component **22** adhered with a polymer adhesive **60** to the pitched roof deck **50**. The roof tiles **10** are adhered with the polymer adhesive **60** to the insulating component **22**. The improved roofing system **100** provides a well insulated roof for energy efficiency.

[**0054**] A few embodiments of a pitched roof system and method of installing same according to the present invention have thus been set forth. However, the invention should not be unduly limited to the foregoing, which has been set forth for illustrative purposes only. Various modifications and alterations of the invention will be apparent to those skilled in the art, without departing from the true scope of the invention.

We claim:

1. A roof panel comprising:

a panel having first and second opposing sides and third and fourth opposing sides, said first side having a first interlocking portion and said second side having a second interlocking portion; and

said fourth side being formed in an overlap portion,

wherein said first interlocking portion of said panel is adapted to mate with a second interlocking portion of a second roof panel and said second interlocking por-

tion of said panel is adapted to mate with a first interlocking portion of a third roof panel, and said overlap portion of said panel is adapted to overlap a third side of a fourth roof panel, with said panel and the second, third and fourth roof panels being of identical construction.

2. The roof panel of claim 1, further comprising:

said panel having an upper surface and a lower surface, said lower surface having a roof contacting portion and an overlapping lower portion, said roof contacting portion and said overlapping lower portion being separated by a shoulder.

3. The roof panel of claim 2, further comprising:

said panel having a thickness which increases from said third side to said shoulder.

4. The roof panel of claim 2, wherein said upper surface between said first and second interlocking portions is substantially planer.

5. The roof panel of claim 2, wherein said shoulder has a height which is substantially equal to said panel thickness at said third side.

6. The roof panel of claim 1, wherein said panel is made from polystyrene, polyurethane or polyisocyanurate.

7. An insulated pitched roof system for insulating a pitched roof deck and attaching roof components thereto, the roof system comprising:

a plurality of insulating panels to be adhered and bonded to the pitched roof deck or to a roof substrate attached to the pitched roof deck, each said insulating panel having first and second opposing sides and third and fourth opposing sides, said first side having a first interlocking portion and said second side having a second interlocking portion, and said fourth side being formed in an overlap portion,

wherein said first interlocking portion of a first said insulating panel is adapted to mate with said second interlocking portion of a second said insulating panel and said second interlocking portion of said first insulating panel is adapted to mate with said first interlocking portion of a third said insulating panel, and said overlap portion of said first insulating panel is adapted to overlap said third side of a fourth said insulating panel, with said first, second, third and fourth roof panels being of identical construction;

a first polymer adhesive to adhere said plurality of insulating panels to the pitched roof deck or the roof substrate; and

a second polymer adhesive to adhere the roof components to said plurality of insulating panels.

8. The insulated pitched roof system of claim 7, wherein said first and second polymer adhesives are identical.

9. The insulated pitched roof system of claim 7, wherein said first and second polymer adhesives are polyurethanes.

10. The insulated pitched roof system of claim 7, wherein said second polymer adhesive is a foamable polymer adhesive.

11. The insulated pitched roof system of claim 10, wherein said second polymer adhesive is a plural component, liquid polyurethane foam.

12. The insulated pitched roof system of claim 7, wherein said first polymer adhesive is a single component polymer adhesive.

13. The insulated pitched roof system of claim 11, wherein said first polymer adhesive is a plural component, liquid polyurethane foam.

14. The insulated pitched roof system of claim 13, wherein said first and second polymer adhesives are identical.

15. The insulated pitched roof system of claim 7, wherein each said insulating panel includes a substantially flat lower surface to be adhered to the pitched roof deck or to the roof substrate.

16. A method of installing an insulated pitched roof system having a plurality of roof tiles and a pitched roof deck, the method comprising the steps of:

adhering, with an adhesive, a plurality of insulating panels to the pitched roof deck to form a lower row of insulating panels and an upper row of insulating panels;

interlocking adjacent insulating panels to one another in the lower row and in the upper row;

overlapping a portion of the lower row of insulating panels with a portion of the upper row of insulating panels adhering the roof tiles to the insulating panels.

17. The method of claim 16, further comprising the step of adhering the upper row of insulating panels to the lower row of insulating panels.

18. The method of claim 17, wherein the adhering is accomplished with a polymer adhesive.

19. The method of claim 16, wherein the overlapping upper row portion aids in the proper placement of the roof tiles on the lower row of insulating components.

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