US 20060207204A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2006/0207204 A1

Wasitis et al. (43) Pub. Date: Sep. 21, 2006

(54) FASTENER, ROOFING SYSTEM AND METHOD

(75) Inventors: **William A. Wasitis**, Indianapolis, IN (US); **James A. Jannasch**, Westfield, IN (US)

Correspondence Address:
Chief Intellectual Property Counsel
Bridgestone Americas Holding, Inc.
1200 Firestone Parkway
Akron, OH 44317-0001 (US)

(73) Assignee: **BFS Diversified Products, LLC**

(21) Appl. No.: **11/374,438**

(22) Filed: **Mar. 13, 2006**

Related U.S. Application Data

(60) Provisional application No. 60/663,064, filed on Mar. 18, 2005.

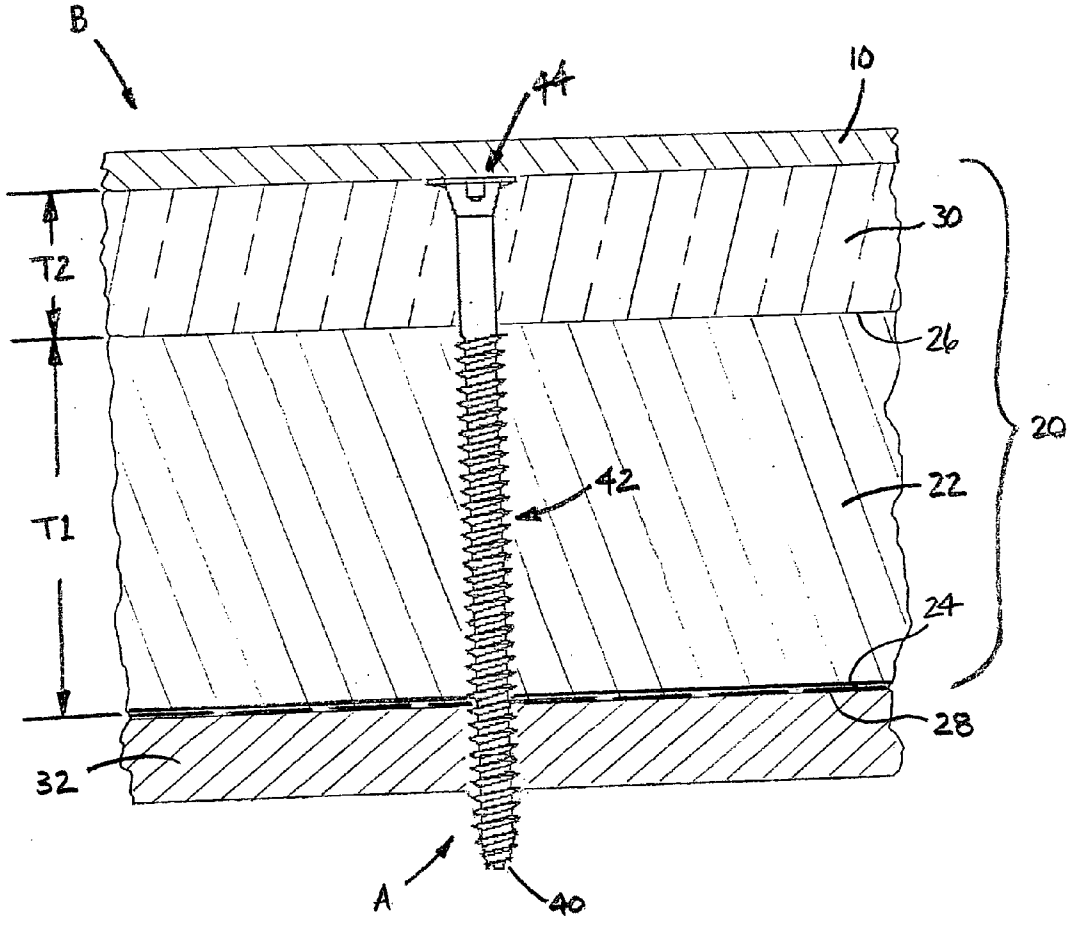
Publication Classification

(51) **Int. Cl.**
E04B 5/00 (2006.01)

(52) **U.S. Cl.** **52/410**

(57) **ABSTRACT**

The present disclosure relates to a penetrating fastener for a roofing system having a flexible waterproof membrane adhesively attached to an upper layer which is fastened to a roof deck. The fastener is dimensioned to extend through the upper layer and threadingly engage the lower roof deck. The fastener includes a self-drilling tip for piercing the upper layer and the roof deck and a self-tapping threaded shank portion located above the tip. An unthreaded shank portion is located adjacent the threaded shank portion. A tapered collar is located above the unthreaded shank portion. The fastener further includes a driving head which has a flange extending at an angle from a first side of the head to the tapered collar for reducing the tensile forces associated with the head being installed flush with or slightly below the upper layer. The unthreaded shank portion, tapered collar and driving head together form an unthreaded length of the penetrating fastener that is at least as great as a thickness of a portion of the upper layer. A method includes attaching a roofing system using the penetrating fasteners.



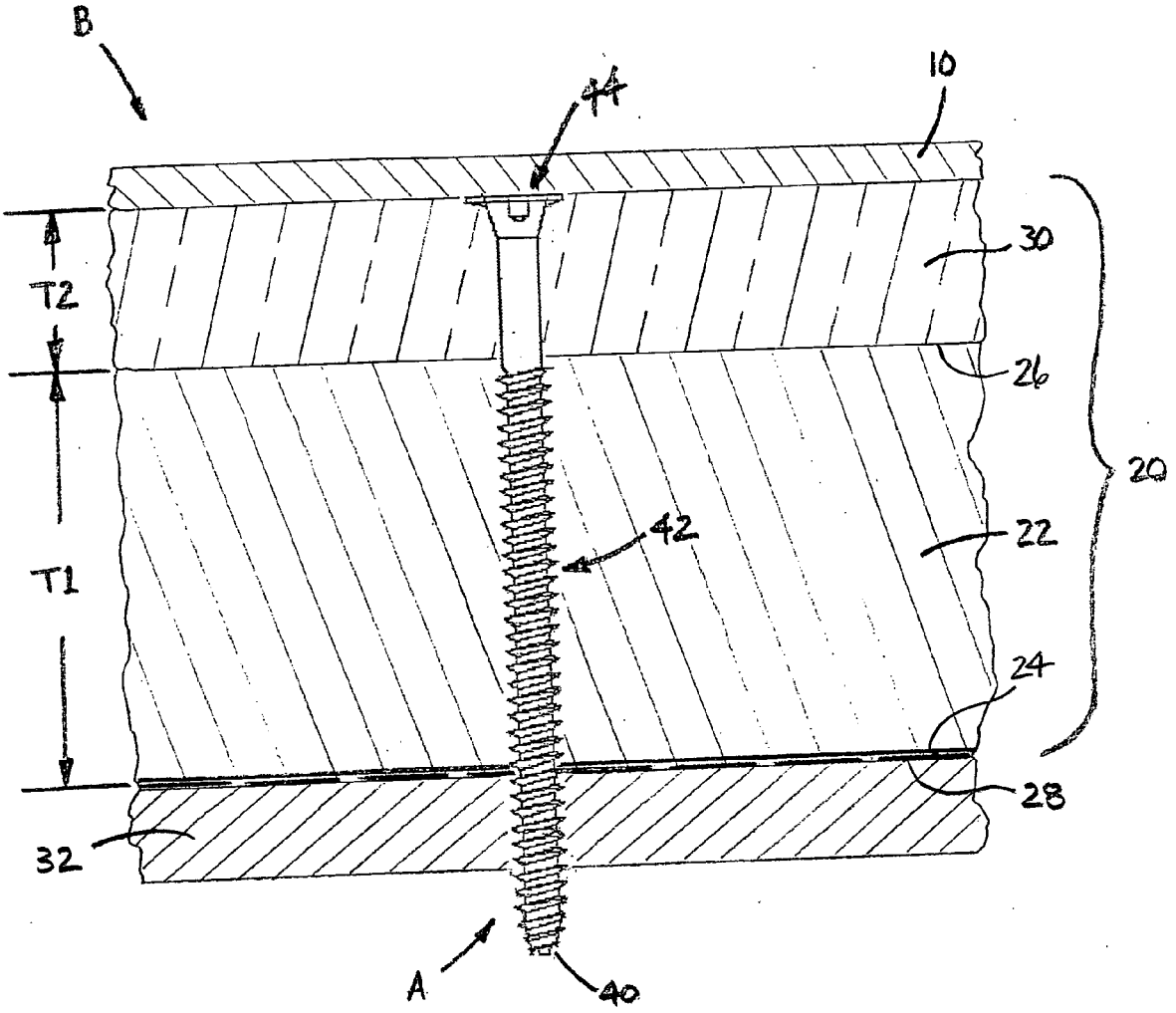


FIGURE 1

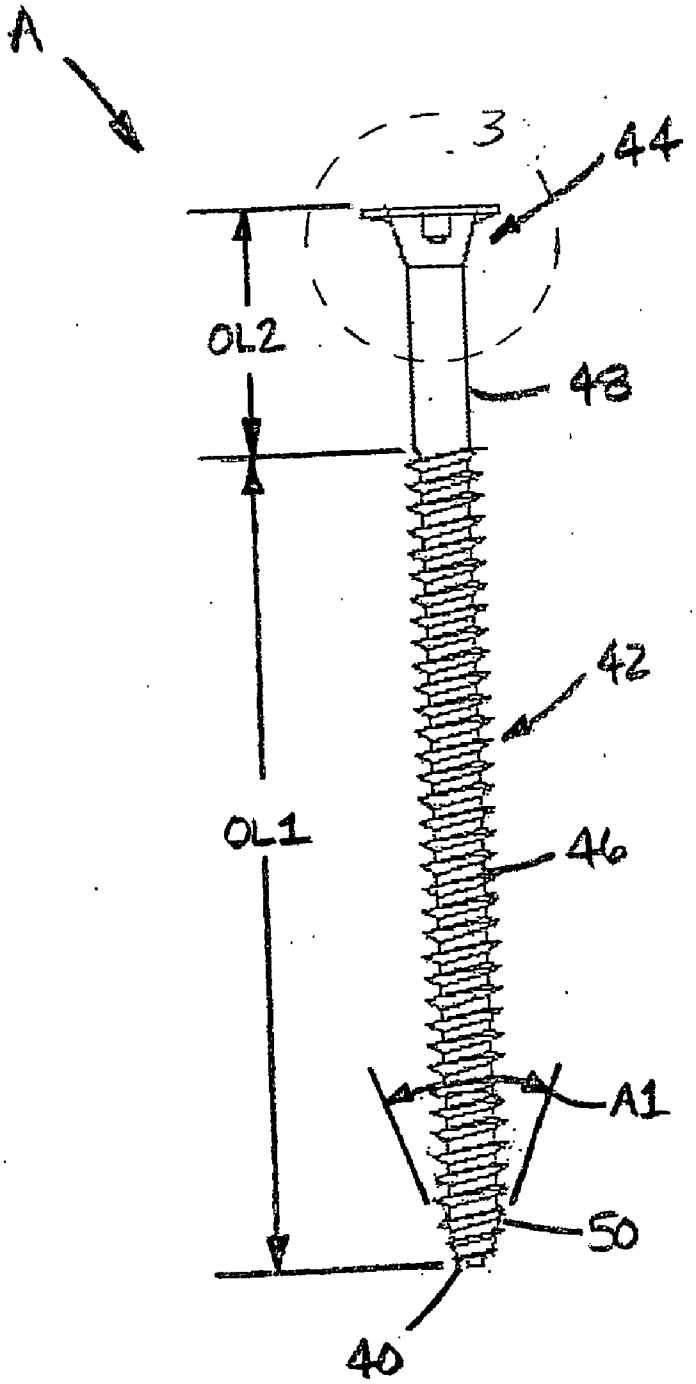


FIGURE 2

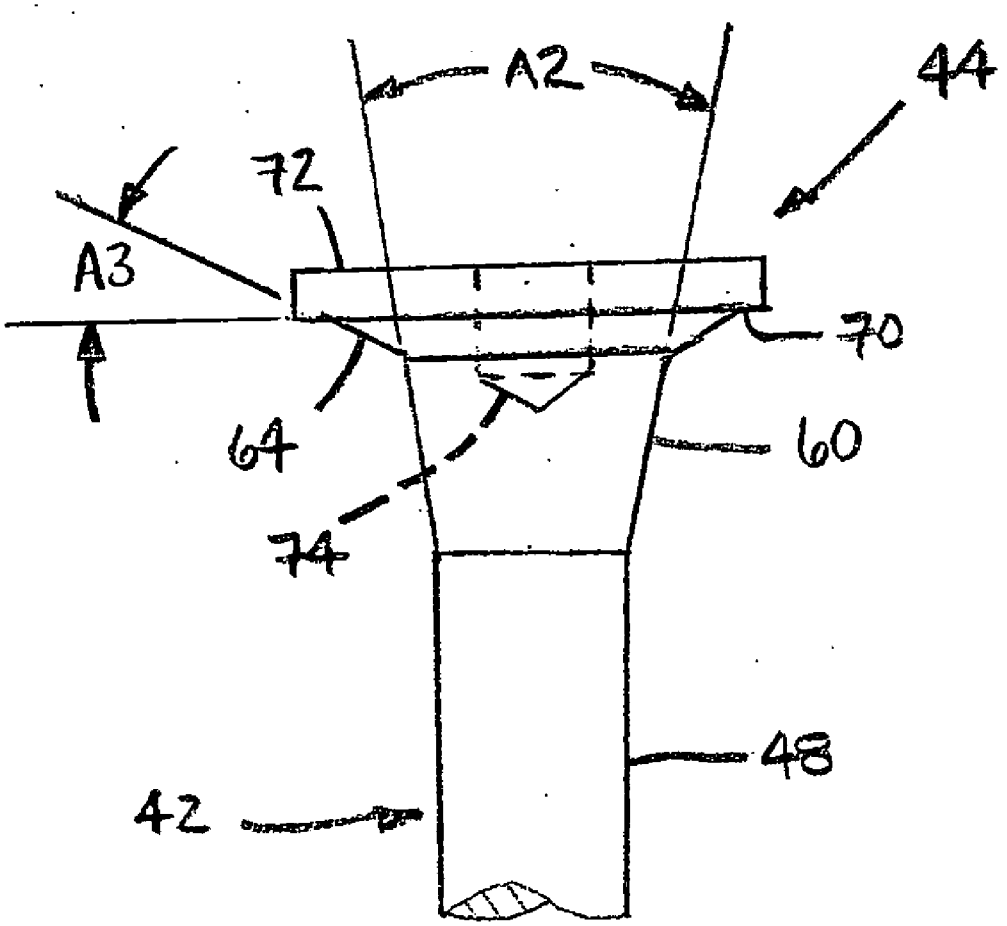


FIGURE 3

FASTENER, ROOFING SYSTEM AND METHOD

[0001] This application claims priority from U.S. Provisional Patent Application No. 60/663,064, filed on Mar. 18, 2005, which is hereby incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] The present invention generally relates to membrane roofing systems, and, more particularly, to a penetrating fastener for securing a first or upper layer of a roofing system to a roof deck and a roofing system including such fasteners. The invention further relates to methods of securing the first or upper layer to the roof deck and of attaching a membrane to the first layer in such a manner that the membrane is not compromised by the fastener.

[0003] A roof deck may be constructed from plywood, metal decking, concrete or any other suitable material. In certain roofing installations for commercial buildings, a first layer is secured to the roof deck. The first layer generally includes a lower thermal performance section, such as a layer of insulation, for example, and an upper structural section, such as a sheet of oriented strand board (OSB) or plywood, for example. To make the roof deck and first layer weather resistant, a single-ply membrane roof is typically installed over the first layer. The single-ply membrane roof is oftentimes a water impermeable single sheet of synthetic, flexible material, such as ethylene propylene diene rubber (EPDM) or thermoplastic polyolefin (TPO), for example.

[0004] The first layer has heretofore been installed on the roof deck using a variety of different methods. For example, the first layer can be secured to a roof deck by utilizing a plurality of small, circular, metal plates, e.g. anchor plates, having an opening in the center. The anchor plates are fastened to the roof via fasteners, e.g. screws or nails, that pass through the plate openings. An enlarged head portion of the fastener does not extend through the opening and thereby secures the plate to the first layer. Alternatively, the first layer can be secured to the roof deck only with fasteners. The metal plates and/or fasteners are then covered by the single-ply membrane in a manner well known in the art.

[0005] Anchor plates are generally manufactured from stamped metal or molded plastic and are usually circular or disc shaped, but can also be oblong. A problem with many presently available anchor plates is that an edge of the plate can contact the membrane during installation and cause the membrane to wrinkle or pinch around the plate. The anchor plates also prevent the membrane from being installed completely flat on the first layer.

[0006] Current fasteners used for attaching the first layer to the roof deck generally have a head with a diameter between 0.60 and 0.70 inches and a thickness between 0.05 and 0.07 inches. As such, when the fasteners are installed, at least a portion of the head protrudes from a top surface of the first layer. Similar to the problems associated with the anchor plates, the head of the fastener can also contact the membrane and cause the membrane to wrinkle or pinch around the fastener. Accordingly, it is desirable to install these large head fasteners flush with or slightly below the top surface of the first layer. However, known fasteners are inclined to strip out of the roof deck when installed in this manner.

[0007] Another important consideration for a single-ply membrane roof system is that the system must withstand a wide range of climatic conditions, for example, wind uplift forces, rain and hail. Consequently, in order to withstand such inclement weather, the membrane must be securely fastened to the first layer and not compromised by an edge of an anchor plate or the head of a fastener. If the membrane is pinched, the membrane may tear thereby making the roofing system susceptible to water damage and/or wind uplift forces. Further, because the anchor plates and fasteners are not installed flush with the first layer, the membrane can be damaged by hail. Also, if an item is dragged over the membrane, the high profile of the anchor plates and fastener heads makes it easier to pinch and damage the membrane.

[0008] Accordingly, it has been considered desirable to develop a roofing system including an improved fastening means which overcomes the foregoing difficulties and others while providing better and more advantageous overall results.

SUMMARY OF THE INVENTION

[0009] In accordance with one aspect of the present invention, a new and improved penetrating fastener for a membrane roofing system is provided.

[0010] More particularly, in accordance with this aspect of the present invention, the roofing system for application to a roof deck generally comprises a first or upper layer; at least one penetrating fastener for attaching the first layer to the deck; and a flexible, water impermeable second layer or membrane adapted to sealingly engage the first layer and the at least one penetrating fastener. The first layer preferably includes a structural section, such as a sheet of oriented strand board (OSB) or plywood, for example, with the structural section having a predetermined thickness.

[0011] In accordance with another aspect of the present invention, the penetrating fastener is dimensioned to extend through the first layer and threadingly engage the lower roof deck. The fastener includes a self-drilling tip which pierces the first layer and the roof deck and a shank located above the tip. The shank includes a self-tapping threaded portion and an unthreaded portion. A tapered collar is located above the unthreaded shank portion. The fastener further includes a driving head which has a flange extending from a first side of the head to the tapered collar. The driving head is installed flush with or slightly below the first layer of the roofing system. The unthreaded shank portion along with the tapered collar and driving head form an unthreaded length of the fastener, which in one preferred embodiment is at least as great as a thickness of the first layer.

[0012] In accordance with still another aspect of the present invention, a method of attaching the flexible waterproof membrane to the first layer is disclosed. The first layer is positioned upon the roof deck and is pierced with a plurality of fasteners. The head of each fastener is installed flush with or slightly below the first layer. The roof deck is threadingly engaged with the threaded shank portion of each fastener thereby securing the first layer to the roof deck. The membrane is then positioned over and adhesively attached to the first layer.

[0013] A benefit of the present invention resides in the ability to provide a single-ply membrane roofing system

having an improved fastener which does not compromise the integrity of the membrane during installation.

[0014] Another benefit of the invention relates to a single-ply membrane roofing system having improved durability under a wide range of climatic conditions and improved resistance to wind uplift forces.

[0015] Still another benefit of the invention is associated with eliminating anchor plates which reduces a substantial amount of the labor normally performed on the roof deck, thereby increasing efficiency and reducing labor costs.

[0016] Yet another benefit of the present invention is to provide a method of installing a single-ply membrane roof to a roof deck that is simple and economical.

[0017] Still other non-limiting benefits and/or aspects of the disclosure will become apparent from a reading and understanding of the description herein below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The present invention may take physical form in certain parts and arrangements of parts, a preferred embodiment of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part of the invention.

[0019] **FIG. 1** shows a cross-sectional view of a roofing system.

[0020] **FIG. 2** is an elevation view of a fastener used in the roofing system of **FIG. 1**.

[0021] **FIG. 3** is an enlarged view of a head portion of the fastener shown in **FIGS. 1 and 2**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0022] It should, of course, be understood that the description and drawings herein are merely illustrative and that various modifications and changes can be made in the structures disclosed without departing from the spirit of the invention. Like numerals refer to like parts throughout the several views.

[0023] Referring now to the drawings, wherein the showings illustrate an embodiment of the invention only and are not intended to limit same, **FIGS. 1-3** show a penetrating fastener A for a roofing system B. Roofing system B typically includes a flexible waterproof roof membrane **10**, generally a single sheet of synthetic, flexible polymer material designed for long term waterproofing performance. Preferably, the roof membrane is an ethylene propylene diene rubber (EPDM) or thermoplastic polyolefin (TPO), however, other synthetic polymers can be used for the roof membrane without departing from the scope and intent of the present invention.

[0024] The roof membrane sealingly engages a first or upper layer **20** and fasteners A. Upper layer **20** provides thermal performance for the roofing system. It generally includes first and second vertically stacked sections. The first section being a thermal performance section that includes an insulation layer **22** having a first or lower surface **24** and a second or upper surface **26** generally establishing a layer thickness T**1**. The insulation layer is preferably a polymer material, such as a closed-cell polyisocyanurate foam core. However, it can be appreciated by one skilled in the art that other polymer materials can be used for the insulation layer. Optionally, a reinforced mat **28** is laminated to first surface **24** of the insulation layer. The reinforced mat can include a black glass reinforced mat face. The second section of upper layer **20** being a structural performance section that can include a sheet **30** of comparatively sized rigid material, such as oriented strand board (OSB) or plywood, for example. In one exemplary embodiment, sheet **30** has a predetermined thickness T**2**, which is commonly 7/16 of an inch, and is attached to second surface **26** of the foam core, such as by using an adhesive, for example.

[0025] The upper layer is fastened to a lower roof deck **32** which is the structural supporting surface of a building extending between the surrounding exterior walls of the building. The roof deck may be constructed from plywood, metal decking, concrete or any other suitable material.

[0026] With continued reference to **FIG. 1**, and additional reference to **FIGS. 2 and 3**, penetrating fastener A is preferably dimensioned to extend through upper layer **20** and threadingly engage lower roof deck **32**. Penetrating fastener A includes a self-drilling tip **40** for piercing upper layer **20** and roof deck **32**, a cylindrical shank **42** and a head **44**. The self-drilling tip should be of sufficient size to penetrate the upper layer and the roof deck and is preferably an X-point drilling tip.

[0027] Shank **42**, which is located adjacent the tip, generally includes a self-tapping threaded portion **46** and an unthreaded portion **48**. Thus, penetrating fastener A includes an overall threaded length OL**1**, which includes tip **40** and threaded portion **46**, and an overall unthreaded length OL**2**, which includes head **44** and unthreaded portion **48**. As shown in **FIG. 1**, unthreaded length OL**2** preferably has a dimension at least as great as thickness T**2** of sheet **30**.

[0028] Threaded portion **46** of the shank has a tapered end portion **50** which assists in the penetration of upper layer **20** and roof deck **32**. In one preferred embodiment, the tapered end portion has an angle A**1** ranging from about twenty degrees (20°) to about thirty degrees (30°), and preferably about twenty-six degrees (26°). However, one skilled in the art will appreciate that the tapered angle can be adjusted depending on the requirements needed for penetrating the upper layer and the roof deck.

[0029] Threaded portion **46** has a major diameter from about 0.25 to about 0.29 inches, and preferably within the range of from about 0.258 to about 0.275 inches, and a minor diameter ranging from about 0.16 to about 0.18 inches, and preferably from about 0.165 to about 0.171 inches. The threaded shank portion can include any suitable number of threads per inch (TPI), such as from 12 to 14 TPI, for example. Typically, the threads have a pitch of about 0.071 inches (14 threads per inch) to 0.083 inches (12 threads per inch), and more preferably approximately 0.077 inches (13 threads per inch). In addition, each thread has a crest approximately 0.008 inches+/−0.001 inches, a depth between 0.048 and 0.051 inches+/−0.001 inches, a first flank angle ranging between about 20° to 35°, and preferably about thirty degrees (30°) and a second flank angle ranging from about six degrees (6°) to about eleven degrees (11°), and preferably about nine degrees (9°). Although, the dimensions of the threaded portion of the fastener can be adjusted depending on the roofing system, these dimensions are preferred.

[0030] With reference to **FIG. 3**, located adjacent unthreaded portion **48** of shank **42** is a tapered collar **60**. The tapered collar has a preferred taper angle A**2** of from about twenty-five degrees (25°) to about thirty-five degrees (35°), and preferably from about thirty-one degrees (31°) to about thirty-three degrees (33°). Driving head **44** includes a flange **64** extending from a first side or underside **70** of the head to tapered collar **60**, preferably at an angle A**3** of from about nine degrees (9°) to about twenty degrees (20°), and more preferably from about twelve degrees (12°) to about fifteen degrees (15°). Flange **64** reduces tensile forces associated with head **44** being installed flush with or slightly below surface **28** by reducing the amount of head thickness that has to be embedded therein. Further, by reducing the tensile forces, threaded portion **46** of fastener A is not inclined to strip out of roof deck **32**. As such, the head can have a reduced diameter compared to that of known fasteners, such as from about 0.49 inches to about 0.53 inches and, in one preferred embodiment, from about 0.500 inches to about 0.522 inches. Additionally, head **44** can have a reduced axial length or thickness compared to known fasteners, such as from about 0.025 inches to about 0.035 inches.

[0031] A second side or upper side **72** of head **44** includes a recess **74** that is preferably configured for handling by automated machinery. Recess **74** can have any suitable non-circular cross-section, such as a rectangular cross-section, for example. However, it can be appreciated by one skilled in the art that recess **74** can have other cross-sections depending on the automated machinery employed to torque or drive fastener A.

[0032] Penetrating fastener A may be constructed from any material having a hardness and strength sufficient for penetrating the upper layer and the roof deck. Preferably, the fastener is fabricated from SAE 1022 or equivalent steel and heat treated. The fastener is further coated with a suitable epoxy for preventing corrosion. The epoxy can be applied by any suitable process, such as by electro-deposition.

[0033] To install the roofing system of the present invention, upper layer **20**, comprising the first thermal performance or cushioning section, such as the insulation layer, and the second structural performance section, such as the structural layer having the OSB/wood surface in the preferred embodiment, is positioned on roof deck **32**. Generally, the upper layer includes at least one four foot by eight foot sheet. Each sheet of the upper layer is penetrated with a plurality of fasteners A, preferably, twelve spaced apart fasteners. Head **44** of each fastener is installed flush with or slightly below the upper or outer surface of the upper layer. By installing the head flush with the upper layer, unthreaded length OL**2**, which includes unthreaded shank portion **48**, of each fastener extends through predetermined thickness T**2** of sheet **30**. Threaded shank portion **46** of each fastener threadingly engages roof deck **32** thereby securing the upper layer to the roof deck.

[0034] Next, waterproof roof membrane **10** is positioned over the upper layer. Because head **44** of fastener A is installed flush with or slightly below upper layer **20**, the roof membrane is not compromised by the head of the fastener. A first portion of the roof membrane is folded onto itself to expose an underside surface of the first portion of the membrane. A bonding adhesive is then applied to a portion of the underside surface of the first portion of the membrane to be secured to the upper layer. The adhesive coated first portion of the membrane is rolled onto the upper layer. A second, un-adhered portion of the membrane is then folded onto the adhesively secured first portion of the membrane to expose an underside surface of the second portion of the membrane. A bonding adhesive is then applied to a portion of the underside surface of the second portion of the membrane to be secured to the upper layer. Finally, the adhesive coated second portion of the membrane is rolled onto the upper layer.

[0035] The present invention has been described with reference to a preferred embodiment. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. For example, a roof contractor may alternately use polyurethane board instead of the polyisocyanurate and optionally a fire retardant underlayment board can be used next to the roof deck to obtain the appropriate or desired fire rating and to prevent the polyurethane board from melting and dripping into the interior of the associated structure in case of a fire. It is anticipated that the fastener discussed herein would have benefits in other applications. Accordingly, it is intended that the exemplary embodiment be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

What is claimed is:

1. A penetrating fastener for an associated roofing system having a flexible waterproof roof membrane, an upper layer covered by the roof membrane, and a lower roof deck, the penetrating fastener dimensioned to extend through the upper layer and threadingly engage the lower roof deck, the fastener comprising:

a self-drilling tip for piercing the upper layer and the roof deck;

a self-tapping threaded shank portion located above the tip;

an unthreaded shank portion located above the threaded shank portion;

a tapered collar located above the unthreaded shank portion; and,

a driving head located above the tapered collar, said driving head including opposing first and second sides and a flange extending from the first side of the head to the tapered collar.

2. The fastener of claim 1, wherein the upper layer of the associated roofing system includes first and second vertically stacked sections with the first section having a first thickness, and wherein the unthreaded shank portion, the tapered collar and the driving head comprise an unthreaded portion extending from the second side of the driving head to a distal end of the unthreaded shank portion, the unthreaded portion having an unthreaded length that is one of equal to or greater than the first thickness.

3. The fastener of claim 2, wherein the second section of the upper layer has a second thickness and includes a foam core having a first surface and an opposing second surface, the lower roof deck has a deck thickness, and the self-drilling tip and the self-tapping threaded shank portion comprise a threaded portion of the penetrating fastener

having a threaded length greater than the sum of the second thickness and the deck thickness.

4. The fastener of claim 2, wherein the first section of the upper layer is a structural section that includes a sheet of material selected from a group consisting of oriented strand board (OSB) and plywood, the first thickness of the first section being approximately 7/16 inches, and the unthreaded shank portion of the penetrating fastener having an axial length of at least approximately ½ inch.

5. The fastener of claim 1, wherein at least the threaded shank portion includes a plurality of threads extending at from 12 threads per inch to 14 threads per inch.

6. The fastener of claim 1, wherein the head has an axial length of from approximately 0.025 to approximately 0.035 inches.

7. The fastener of claim 1, wherein the flange of the head extends from the first side of the head to the tapered collar at an angle between about 9° and about 20°.

8. The fastener of claim 1, wherein the driving head has a diameter from approximately 0.49 to approximately 0.53 inches.

9. The fastener of claim 1, wherein the tapered collar of the fastener has a taper angle between about 25° and about 35°.

10. The fastener of claim 1, wherein the second side of the driving head includes a non-circular recess.

11. A roof system for application to an associated roof deck, the roof system comprising:

a first layer including first and second vertically stacked sections, the first section being a structural performance section having a first thickness, and the second section being a thermal performance section having a second thickness;

at least one penetrating fastener for attaching the first layer to the associated roof deck, the fastener including:

a self-drilling tip for piercing the first layer and the associated deck,

a self-tapping threaded shank portion located adjacent the tip for threadingly engaging a portion of the first layer and a portion of the associated roof deck,

a unthreaded shank portion located adjacent the self-tapping threaded shank portion,

a tapered collar located above the unthreaded shank portion, and,

a driving head located adjacent the tapered collar, and including a non-circular recess and a flange extending at an angle from a first side of the head to the tapered collar for reducing the tensile forces associated with the head being installed flush with or slightly below the first layer; and,

a flexible, water impermeable second layer adapted to sealingly engage the first layer and the at least one penetrating fastener.

12. The system of claim 11, wherein the first thickness of the first section is approximately 7/16 of an inch.

13. The system of claim 11, wherein the second section includes a foam core having a first surface and a second surface and a reinforced mat secured to the first surface of the foam core.

14. The system of claim 11, wherein the second layer includes a synthetic polymer selected from a group consisting of an ethylene propylene diene rubber and thermoplastic polyolefin.

15. The system of claim 11, wherein the at least one penetrating fastener includes a plurality of penetrating fasteners disposed in spaced apart relation along the first layer to secure the first layer to the associated roof deck.

16. The system of claim 11, wherein the unthreaded shank portion, the tapered collar and the driving head comprise an unthreaded length of the at least one penetrating fastener, and the unthreaded length is one of equal to or greater than the first thickness of the first section.

17. The system of claim 11, wherein the self-drilling tip and self-tapping threaded shank portion comprise a threaded length of the at least one penetrating fastener, the associated roof deck has a deck thickness, and the threaded length is one of equal to or greater than a sum of the second thickness and the deck thickness.

18. A method of attaching a flexible waterproof membrane and a first layer of roofing material to a roof deck, the first layer of roofing material including first and second vertical sections, and the first section being a structural performance section having a first thickness, the second section being a thermal performance section having a second thickness, the method comprising the steps of:

positioning the first layer upon the roof deck;

piercing the first layer with a plurality of fasteners;

installing a head of each fastener flush with or slightly below the first layer;

threadingly engaging the deck with a threaded shank portion of each fastener thereby securing the first layer to the roof deck; and,

positioning the membrane over the first layer and the plurality of fasteners.

19. The method of claim 18 comprising the further step of extending an unthreaded shank portion of each fastener through the first thickness of the first section.

20. The method of claim 18 comprising the further steps of folding a first portion of the membrane onto itself to expose an underside surface of the first portion of the membrane:

applying a bonding adhesive to a portion of the underside surface of the first portion of the membrane to be secured to the first layer;

rolling the adhesive coated first portion of the membrane onto the first layer;

folding a second, un-adhered portion of the membrane onto the adhesively secured first portion of the membrane to expose an underside surface of the second portion of the membrane;

applying a bonding adhesive to a portion of the underside surface of the second portion of the membrane to be secured to the first layer; and,

rolling the adhesive coated second portion of the membrane onto the first layer.

* * * * *