PATENT ASSIGNMENT COVER SHEET

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NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
EXTERIOR RESEARCH AND DESIGN, L.L.C	09/30/2022
TRINITY | ERD	09/30/2022

RECEIVING PARTY DATA

Name:	SOCOTEC CONSULTING, INC.
Street Address:	151 W 42ND STREET
Internal Address:	24TH FLOOR
City:	NEW YORK
State/Country:	NEW YORK
Postal Code:	10036

PROPERTY NUMBERS Total: 5

Property Type	Number
Patent Number:	9447626
Patent Number:	10378269
Patent Number:	9200456
Patent Number:	6725610
Patent Number:	8555589

CORRESPONDENCE DATA

Fax Number: (215)656-2498

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 215-656-3381
Email: pto.phil@dlapiper.com
Correspondent Name: IP GROUP OF DLA PIPER LLP (US)
Address Line 1: ONE LIBERTY PLACE
Address Line 2: 1650 MARKET ST. SUITE 5000
Address Line 4: PHILADELPHIA, PENNSYLVANIA 19103

ATTORNEY DOCKET NUMBER:	438087-000005
NAME OF SUBMITTER:	WILLIAM L. BARTOW
SIGNATURE:	/William L. Bartow/
DATE SIGNED:	10/19/2022

Total Attachments: 63
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PATENT ASSIGNMENT

This **Patent Assignment Agreement** (the "Patent Assignment") is made and entered into as of September 30, 2022 (the "Effective Date") by and between Exterior Research and Design, L.L.C. and Trinity | ERD collectively "Assignors" and, each, an "Assignor"), and Socotec Consulting, Inc. ("Assignee"). Assignee and Assignors are sometimes referred to herein individually as a "Party" and collectively as the "Parties".

WHEREAS, an Assignor owns all right, title and interest in and to the patents and patent applications set forth on Schedule I attached hereto (the "Patents").

WHEREAS, Assignors and Assignee have entered into that certain Asset Purchase Agreement (the "Purchase Agreement"), dated as of September 30, 2022, pursuant to which Assignors have agreed to assign certain intellectual property to Assignee, including the Patents, pursuant to this Patent Assignment.

WHEREAS, Assignors wish to assign to Assignee, and Assignee wishes to assume, all of Assignors' right, title and interest in and to the Patents, including all inventions and discoveries disclosed or claimed therein or encompassed thereby, statutory invention registrations, revisions, extensions, divisionals, continuations, continuations-in-part, reexaminations, reissues and all foreign applications and patents relating thereto (collectively, the "Assigned Patents").

NOW, THEREFORE, in consideration of the foregoing and the Purchase Agreement, and for other good and valuable consideration furnished by Assignee to Assignors, the receipt, adequacy and legal sufficiency of which are hereby acknowledged by the Parties:

1. As of the Effective Date, Assignors agree to assign, transfer, sell and convey, and hereby assign, transfer, sell and convey to Assignee, its successors and assigns, and Assignee hereby accepts, all of Assignors' right, title, and interest in and to the Assigned Patents, together with all inventions and discoveries disclosed or claimed therein or encompassed thereby, statutory invention registrations, revisions, extensions, divisionals, continuations, continuations-in-part, reexaminations and reissues relating thereto, and any applications filed and/or granted in foreign countries and all other corresponding rights that are or may be hereafter secured under the laws of any country, now or hereafter in effect, for Assignee's own use and enjoyment, and for the use and enjoyment of Assignee's successors, assigns or other legal representatives, as fully and entirely as the same would have been held and enjoyed by such Assignor if this Patent Assignment had not been made, including all right, title and interest in and to all income, proceeds, royalties, damages, claims and payments which accrue, or have accrued, prior to and as of the Effective Date or thereafter and are due or payable after the Effective Date with respect thereto, and in and to all causes of action, either at law or in equity, for any past, present or future infringement of the Assigned Patents, or other violation or unauthorized use of the Assigned Patents, with the right to sue for, and collect the same.

2. Assignors authorize and request the Commissioner of Patents and Trademarks of the United States of America and the empowered officials of all other corresponding entities or agencies of other applicable governments or jurisdictions to issue or transfer the Assigned Patents

to Assignee, as assignee of the entire right, title, and interest therein or otherwise as Assignee may direct.

3. The Parties acknowledge and agree that certain documents may need to be executed and delivered by Assignors to effectuate transfer of title to the Assigned Patents to Assignee. Assignors agree to provide to Assignee and Assignee's successors, assigns or other legal representatives, all such cooperation and assistance (including, without limitation, the execution and delivery of any affidavits, declarations, oaths, exhibits, assignments, powers of attorney or other documentation), reasonably requested by Assignee to more fully and effectively effectuate the purposes of this Patent Assignment, at Assignee's sole expense.

4. The Parties acknowledge and agree that this Patent Assignment is entered into pursuant to the Purchase Agreement, to which reference is made for a further statement of the rights and obligations of Assignors and Assignee with respect to the Assigned Patents. The representations, warranties, covenants, agreements, and indemnities contained in the Purchase Agreement shall not be superseded hereby but shall remain in full force and effect to the full extent provided therein. In the event of any conflict or inconsistency between the terms of the Purchase Agreement and the terms hereof, the terms of the Purchase Agreement shall govern.

5. Each provision of this Patent Assignment will be interpreted in such a manner as to be effective and valid under applicable law, but if any term or other provision of this Patent Assignment is held to be invalid, illegal or unenforceable under applicable law, all other provisions of this Patent Assignment shall remain in full force and effect.

6. This Patent Assignment may be executed in counterparts, each of which will be deemed an original, but all of which together constitute one and the same original. A signed copy of this Patent Assignment delivered by facsimile, e-mail, or other means of electronic transmission shall be deemed to have the same legal effect as delivery of an original signed copy of this Patent Assignment. This Patent Assignment may not be amended except by an instrument in writing signed by each of the Parties hereto.

7. This Patent Assignment shall be governed by and construed in accordance with the Laws of the State of Delaware without giving effect to any choice or conflict of law provision or rule (whether of the State of Delaware or any other jurisdiction) that would cause the application of the laws of any jurisdiction other than the State of Delaware.

[***Remainder of page intentionally left blank.***
Signature page follows.]

IN WITNESS WHEREOF, the Parties have executed this Patent Assignment as of the Effective Date.

ASSIGNORS:

Trinity | ERD

By: _____
Name: Colin Murphy
Title: Managing Partner

Exterior Research and Design, L.L.C.

By: _____
Name: Colin Murphy
Title: Managing Partner

ASSIGNEE:

SOCOTEC CONSULTING, INC.

By: _____
Name: Marc Weissbach
Title: CEO

Schedule I to Patent Assignment

ASSIGNED PATENTS AND PATENT APPLICATIONS

PATENTS

TITLE	JURISDICTION	PATENT NUMBER	ISSUE DATE
SILL PAN	UNITED STATES	US 9,447,626 B2	SEPTEMBER 20, 2016
SILL PAN	UNITED STATES	US 10,378,269 B2	AUGUST 13, 2019
JOINER CLIP	UNITED STATES	US 9,200,456 B2	DECEMBER 1, 2015
WINDOW SEAL CONSTRUCTION	UNITED STATES	US 6,725,610 B2	APRIL 27, 2004
ROOFING SYSTEM	UNITED STATES	US 8,555,589 B2	OCTOBER 15, 2013

Copies of Patents Attached

Initials: _____

Initials: _____

Initials: _____

US009447626B2

(12) **United States Patent**
Murphy

(10) **Patent No.: US 9,447,626 B2**
(45) **Date of Patent: Sep. 20, 2016**

(54) **SILL PAN**

(71) Applicant: **Exterior Research and Design, L.L.C.**, Seattle, WA (US)

(72) Inventor: **Colin R. Murphy**, Seattle, WA (US)

(73) Assignee: **Exterior Research and Design, L.L.C.**, Seattle, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 186 days.

(21) Appl. No.: **14/487,850**

(22) Filed: **Sep. 16, 2014**

(65) **Prior Publication Data**

US 2015/0075245 A1 Mar. 19, 2015

Related U.S. Application Data

(60) Provisional application No. 61/878,442, filed on Sep. 16, 2013.

(51) **Int. Cl.**

E06B 1/70	(2006.01)
B21D 11/10	(2006.01)
E06B 1/62	(2006.01)
B21D 5/16	(2006.01)

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

CPC ***E06B 1/70*** (2013.01); ***E06B 1/702*** (2013.01); *B21D 5/16* (2013.01); *B21D 11/10* (2013.01); *E06B 2001/628* (2013.01); *Y10T 29/49623* (2015.01)

(58) **Field of Classification Search**

CPC E06B 2001/628; E06B 1/70–1/705; E06B 7/14; E06B 1/62; E06B 1/64; E06B 1/68; B21D 5/00; B21D 5/16; B21D 11/10; B21D 53/74; Y10T 29/49623

See application file for complete search history.

(56) **References Cited**

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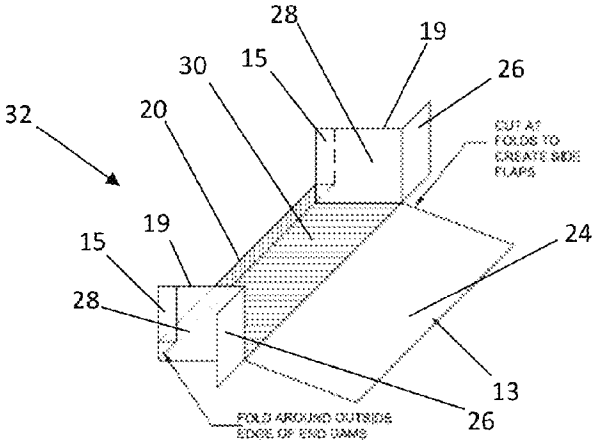
Primary Examiner — Christopher Besler
Assistant Examiner — Matthew P Travers
(74) *Attorney, Agent, or Firm* — Avery N. Goldstein; Blue Filament Law PLLC

(57) **ABSTRACT**

A method for forming a sill pan is provided that includes the measurement of a width and length of an opening sill to be sealed. A piece of flexible sill pan material is cut based on the measured opening sill. Fold lines and cuts are created in the piece to form the sill pan. The resulting sill pan is readily formed to have at least one attribute of self-adherence, draining without shims, nail hole self-sealing, and provision of dams without resort to frame cutting.

6 Claims, 1 Drawing Sheet



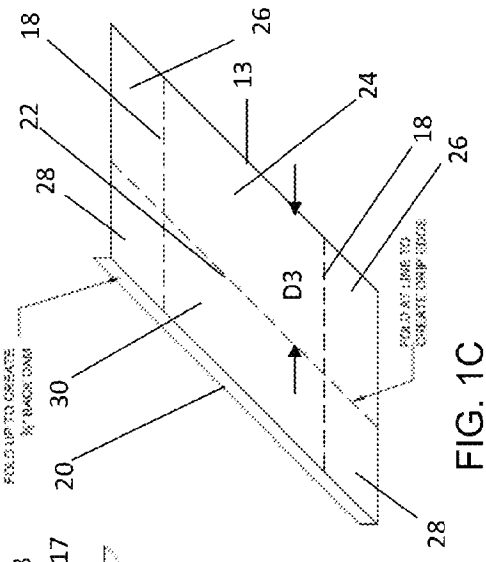


FIG. 1C

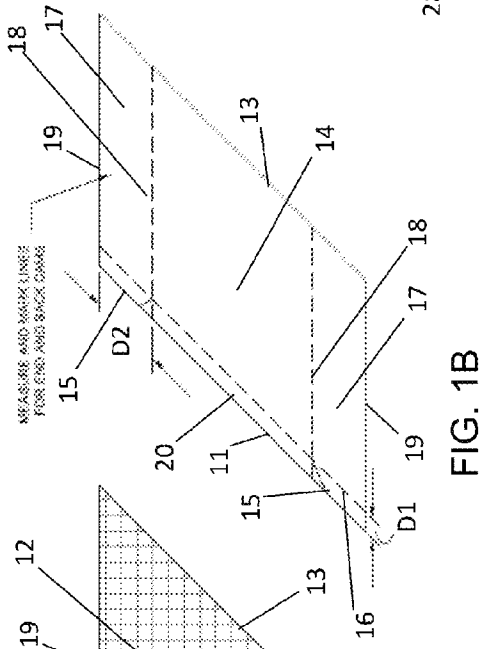


FIG. 1B

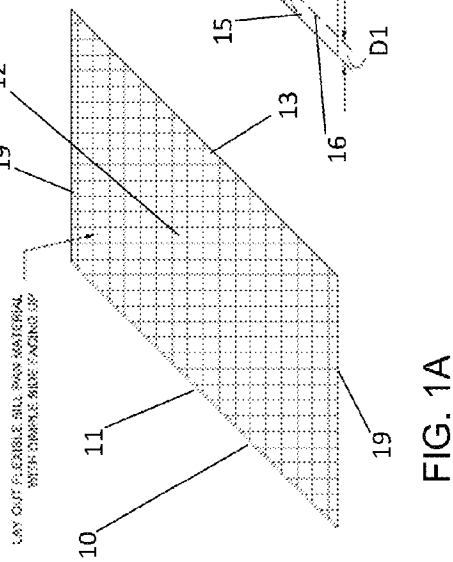


FIG. 1A

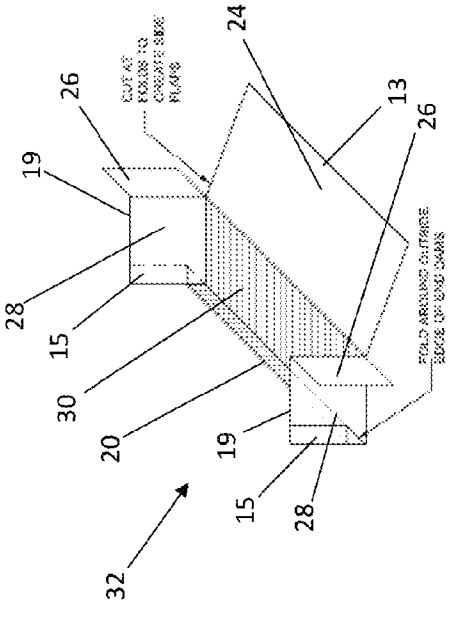


FIG. 1D

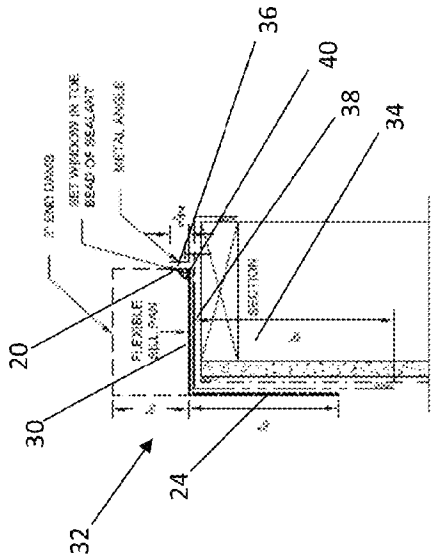


FIG. 2

SILL PAN

RELATED APPLICATIONS

This application claims priority benefit of U.S. Provisional application Ser. No. 61/878,442 filed Sep. 16, 2013; the contents of which are hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention in general relates to building products for weatherproofing window and door installations and in particular, to a sill pan adapted to waterproof a sill surface and a method for forming the sill pan.

BACKGROUND OF THE INVENTION

The incursion of unwanted air and/or moisture into buildings and homes around door and window joints is a major concern for builders, property owners, and occupants. The penetration of air and/or moisture is a serious concern, and may result in exterior and interior damage if not prevented or corrected in a timely manner. In addition, heat losses caused by air leakage around building openings have taken on new significance due to today's high energy costs. Sealing such openings has typically been accomplished by caulking or using putty-like compound around openings between door and window frames to seal the gaps and prevent inward seepage of air and/or water into a building.

An existing approach to sealing window joints is the use of a sill pan to flash windows into a window opening. The sill pan is typically made of metal and is formed in an off-site fabrication shop based on measurements made of the opening at the building site. Typically there are variations in the size for each window so each pan is somewhat unique. Furthermore, if the measurement is not precise, the pan will not fit correctly, and must be remade or swapped around to make sure the sill pans fit each opening. An additional problem with metal sill pans is that sill pans create a thermal short from outside to inside of the window to be sealed due to the pans large mass, and creates condensation on the inside of the window at the sill.

A recent more common practice is the use of polyvinyl chloride (PVC) for sealing panels for windows. The PVC is made in two pieces that slide so they can be used in residential applications, which have become more common. The PVC based sill pans slide to fit the opening and are then sealed with glue or sealant to make a watertight assembly. The PVC based products can have built-in shims and other elements to create a slope for directing water drainage. The PVC material is usually thicker than metal. However, plasticized PVC can also have compatibility problems with bitumen based membranes. Furthermore, the PVC based sill product has openings at the point of connection of the two pieces that can be prone to leakage. Both the aluminum and plastic sill pans need to be bonded to the underlying surface so no water can pass underneath, which is typically achieved with non-skinning butyl beads or tapes.

A further trend has been the increased use of vinyl windows in recent years. However, it has been generally been recognized that vinyl windows take in water and can leak at the sills notwithstanding the weep holes built into the frame at the sill. Therefore, the use of vinyl windows has significantly increased the use of sill pans, not just flashing membranes. Many manufacturers now encourage the use of sill pans. An available option is to create a pan from a self-adhered membrane cutting it to fit. A self-adhered membrane that is cut to fit has the advantage of sealing to the underside of the window and forming the product in the field that it is not rigid. The self-adhered membrane will not allow drainage since the window will create a seal unless shims are put under the window to create sufficient space to create drainage. Many manufacturers of vinyl windows want the window to be fully supported which means shims do not work with their vinyl window designs. Furthermore, the membrane is not very durable and the cutting of the membrane can create joints and pinholes that must be filled with sealant to make sure a seal is created.

While many materials and approaches for sealing window and door joints have been tried, there still exists a need for a material and method of application that can be used for a sill pan that has the advantages of a self-adhered membrane, but can drain without shims, and has sufficient sealing materials to seal around nail holes, while being thin enough to properly function and provide end and back dams without cutting the material.

SUMMARY OF THE INVENTION

A method for forming a sill pan is provided that includes the measurement of a width and length of an opening sill to be sealed. A piece of flexible sill pan material is cut based on the measured opening sill. Fold lines and cuts are created in the piece to form the sill pan. The resulting sill pan is readily formed to have at least one attribute of self-adherence, draining without shims, nail hole self-sealing, and provision of dams without resort to frame cutting.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A-**1**D illustrate a method for forming a sill pan from a sheet material according to embodiments of the invention; and

FIG. **2** is a side perspective cut away view of an installed sill pan according to embodiments of the invention.

DESCRIPTION OF THE INVENTION

The present invention has utility for sealing window and door joints and provides a material and method of forming and application of the seal that can be used for a sill pan that has the advantages of a self-adhered membrane, but can drain without shims, and has sufficient sealing materials to seal around nail holes, while being thin enough to properly function and provide end and back dams without cutting the material.

Embodiments of the inventive sill pan may be formed from a waffled aluminum membrane that has a thick butyl backed adhesive on the back, or other materials that inhibit moisture and can be used in the inventive method of forming sill pans. The waffled aluminum membrane is sold as a roll good that can be cut with scissors. The roll goods can be taken to an application or construction site and cut to size as required. In the inventive method for forming a sill pan, instead of cutting and sealing to form the pan, the material is folded to form the end and back dams so there is no hole or bonded surface. In the inventive method, the end dams and back dams of a sill pan may be formed to any required height. In forming the sill pan, the waffled aluminum membrane material is rigid enough to stand up by itself, so that the majority of a backing may be removed leaving the last one-inch, so the material can be turned up when the sill trim at the back of the window interior is installed. Alternatively in an embodiment, the back dam may be formed with a metal

angle to which the back dam can be immediately bonded creating a free standing back dam. The waffle pattern on the face of the aluminum membrane creates a drainage course. If water were to travel through the window the pan will pick it up. The waffle pattern in the membrane material allows the water to drain to the exterior without putting the window to be sealed on shims. The pan can be sloped by gently sloping the sill framing or adding a continuous wood 'chair' with very gentle sloping. The thick butyl backing of the membrane material acts to seal around penetrations. The aluminum surface is compatible with all materials currently in use as a flashing material. Packaged as a rolled good, the aluminum membrane allows for the expansion of the sill to the exterior to any amount the installer requires.

In installations where metal sills are usually exposed, embodiments of the inventive sill pan are more appropriate for a 'nail-on' window that used to be sealed with a nailing flange on all four sides. The concept used by builders today is to leave the sill open to allow and water that enters to drain out instead of entering the building, but to avoid air from entering the building to create an exterior air barrier. The waffled aluminum membrane material achieves the desired sealing performance by allowing drainage at the bottom, and sealing the window to the back dam with a butyl or polyurethane seal. Self-adhered membranes typically have a polyethylene face that serves as a water impervious barrier, and is not a good surface for sealant bonding. However, while the aluminum face of the waffled aluminum membrane material, used in embodiments of the inventive sill pan, also has a zero perm it still also provides a good sealing surface. The aluminum membrane is thick enough to provide rigidity, but thin enough to cut with scissors and to create a thin profile.

Referring now to the figures, FIGS. **1**A-**1**D illustrate an inventive method for forming a sill pan **32**. It is noted that a waffled or dimpled aluminum membrane is the material used in the example embodiment shown; however additional sheet materials may be used to carry out the inventive method. In FIG. **1**A, a rectangular sheet of flexible sill pan material **10** with the dimple or waffle side **12** showing is laid out and cut to a required size for a window sealing application. In general the inner **11** and outer **13** edges are along the long dimension of the cut sheet **10**. In FIG. **1**B, the smooth surface **14** of the flexible sill pan material **10** is shown, and the surface is measured and marked as follows with a first fold line **16** that defines the height of a back dam **20** at a first distance measured from the inner edge, and a second fold line **18** that defines a rectangular area **17** on opposing sides of the flexible sill pan made up of folded segments **26** and **28** (see FIG. **1**C) that define side flaps and the end dams, respectively. The first fold line **16** is parallel to the long side of the rectangular sheet **10**. The pair of second fold lines **18** are perpendicular to the first fold line **16** and are parallel to short side dimension of the sheet **10** at a second distance (D**2**) measured from the side edges **19**. In FIG. **1**C, a third fold line **22** is added that is parallel to the first fold line **16** at a third distance (D**3**) as measured from the outer edge, and bisects the sheet **10**. Fold line **22** defines the width of the seat **30** of sill pan **10** for seating the window frame, and the downward flap **24** that extends down the wall **34** (see FIG. **2**) below the window sill. The fold along third fold line **22** also creates a drip edge. Additionally in FIG. **1**C, the back dam **20** is folded upward along fold line **16** relative to the seat **30**. In FIG. **1**D, a cut is made along second fold lines **18** that extend from the outer edge **13** until the third fold line **22**, and the segments **26** and **28** that form the side flaps and the end dams, respectively are bent upward and perpendicular to the seat **30**. The side flaps **26** are subsequently bent away from the seat **30** and made perpendicular to the end dams **28**. The opposing ends **15** of back dam **20** that are defined by the area between the inner edge **11**, first fold line **16**, and second fold lines **18** are folded upward after a small cut is made to first fold line **16** that extends from the side edges **19** to the second fold line **18**. The upward opposing ends **15** seal against the end dams **28**. The entire sill pan **32** formed above is now ready to be placed in the opening for the window sealing application.

FIG. **2** is a side perspective cut away view of an installed sill pan **32** in a building wall opening **34** prior to placement of a window frame (not shown) according to embodiments of the invention. As shown the downward flap **24** extends down the wall **34**. Metal angle **36** provides vertical support to back dam **20**, and seat section **30** of the flexible sill pan **32** fits onto the sill **38** of the window opening. A toe bead of sealant **40** is placed at the right angle bend between the seat **30** and back dam **20**. When placing the window frame the bottom rear edge of the window frame is set into the toe bead of sealant **40**.

The invention claimed is:

1. A method for forming a sill pan, said method comprising:

measuring a width and length of an opening sill to be sealed;

cutting a piece of flexible sill pan material based on the measured opening sill;

and creating fold lines and cuts in said piece to form the sill pan;

wherein said piece is rectangular and has a first surface, a second surface, an inner edge, an outer edge, and a pair of side edges, where the inner edge and the outer edge are parallel to each other and perpendicular to the side edges;

creating a first fold line on said first surface that defines the height of a back dam at a first distance measured from the inner edge; creating a set of two second fold lines on said first surface that are perpendicular to said first fold line and are parallel to said side edges at a second distance measured from both of said side edges: and creating a third fold line on said first surface parallel to said first fold line at a third distance as measured from the outer edge that defines a width of a seat of said sill pan for seating a window frame, and a downward flap;

cutting said set of two second fold lines that extend from the outer edge until the third fold line; and cutting said first fold line from opposing sides from said side edges until said second fold lines to form opposing ends.

2. The method of claim **1** further comprising: folding said first fold line upward to create a back dam that is perpendicular to said seat; and folding said set of two second fold lines upward to form two side flaps and end dams that are perpendicular to said seat.

3. The method of claim **2** further comprising: bending said side flaps outward and perpendicular to said end dams; and bending said opposing ends upward to seal against said end dams.

4. The method of claim **1** wherein said second surface of said flexible sill pan material is waffled or dimpled.

5. The method of claim **1** wherein said flexible sill pan material is an aluminum membrane.

6. The method of claim **1** wherein said flexible sill pan material further comprises a butyl backed adhesive.

* * * * *

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Murphy

(10) **Patent No.: US 9,200,456 B2**
(45) **Date of Patent: Dec. 1, 2015**

(54) **JOINER CLIP**

(71) Applicant: **TRINITY ERD**, Seattle, WA (US)

(72) Inventor: **Colin R. Murphy**, Seattle, WA (US)

(73) Assignee: **EXTERIOR RESEARCH & DESIGN LLC**, Seattle, WA (US)

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(21) Appl. No.: **13/940,855**

(22) Filed: **Jul. 12, 2013**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
E04B 2/30 (2006.01)
E04F 13/08 (2006.01)

(52) **U.S. Cl.**
CPC ***E04F 13/0801*** (2013.01); ***E04F 13/0828*** (2013.01); ***E04F 13/0869*** (2013.01)

(58) **Field of Classification Search**
CPC E04F 13/0801; E04F 13/0869; E04F 13/0871; E04F 21/1855; E04B 2001/405; E04B 2/721; E04B 2/723
USPC 52/489.1, 489.2, 522, 543, 582.1, 546, 52/553, 560
See application file for complete search history.

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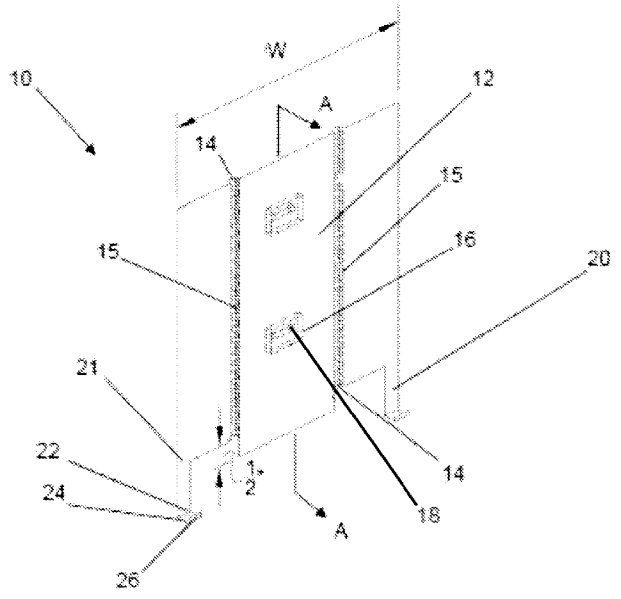
Primary Examiner — Patrick Maestri
(74) *Attorney, Agent, or Firm* — Avery N. Goldstein; Blue Filament Law

(57) **ABSTRACT**

A joiner clip for securing panels to a substrate is provided that includes a planar sheet of material that has a bottom portion terminating in outer edges. A pair of legs extends downward from the outer edges and terminating in a retaining shelf clip adapted to support a bottom edge of an inserted panel. Mounting holes form countersunk indents in the planar sheet that offsets the joiner clip from the substrate. A construction unit is also provided has such a joiner clip secured to a vertical stud substrate. At least inserted panel is supported in the retaining shelf clip of a first leg of the clip. A joint is readily formed between two inserted panels. Fasteners through an inserted panel secure the same to the clip and substrate. An additional siding strip is readily secured to the substrate below the pair of legs.

18 Claims, 9 Drawing Sheets



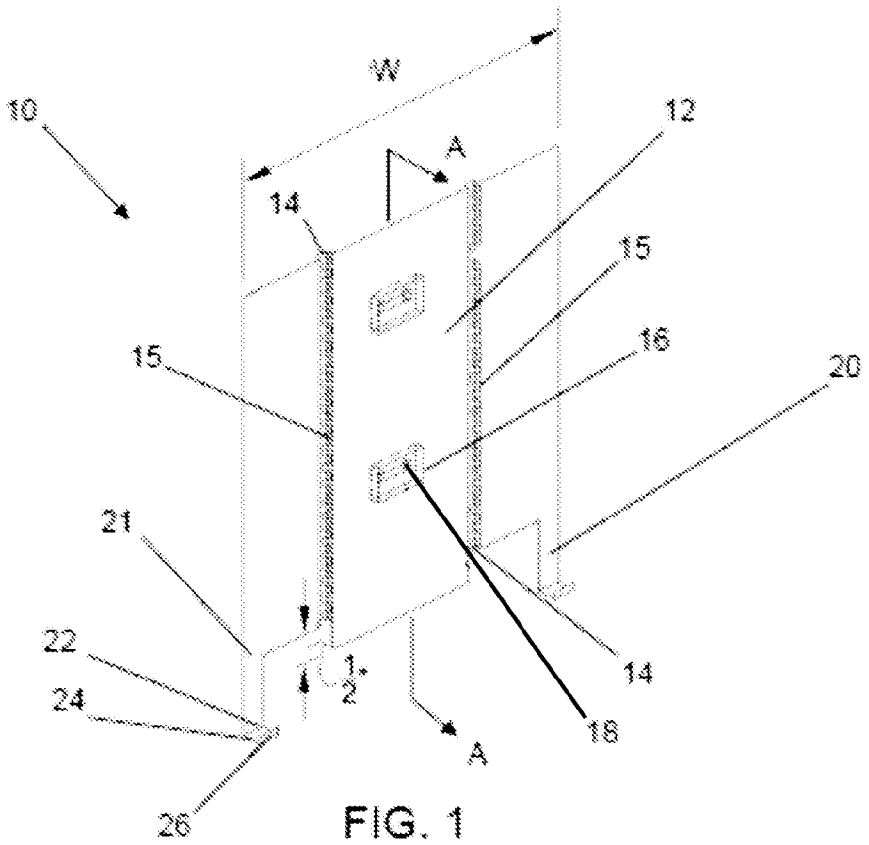


FIG. 1

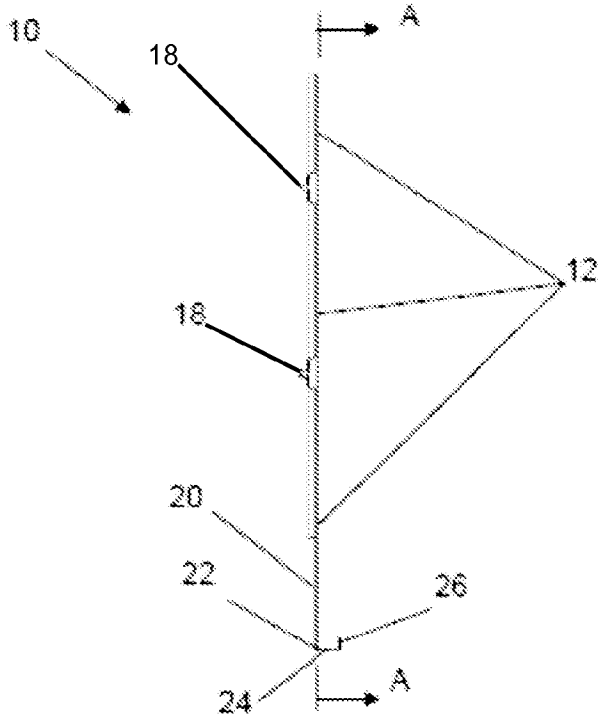


FIG. 2

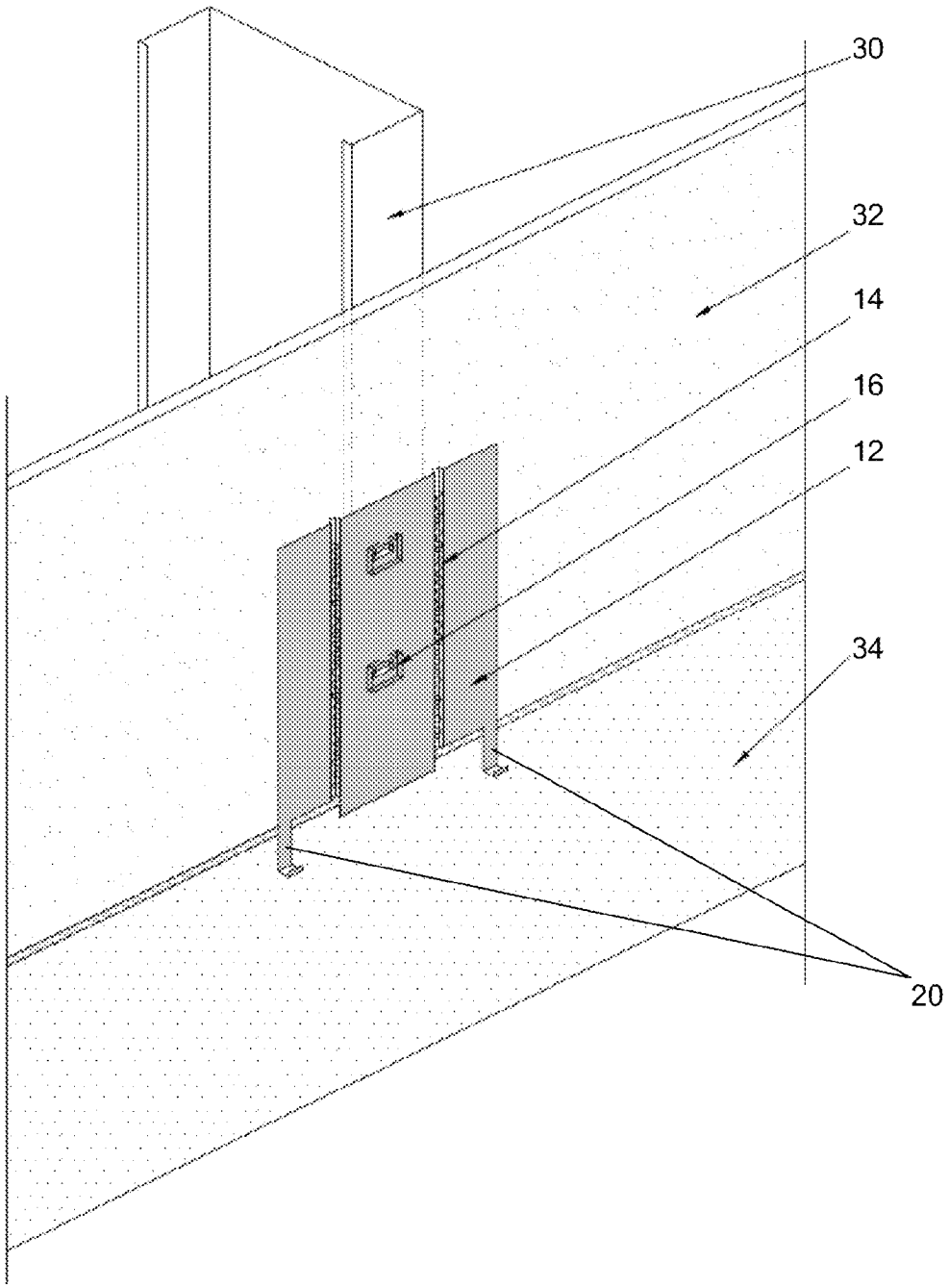


FIG. 3

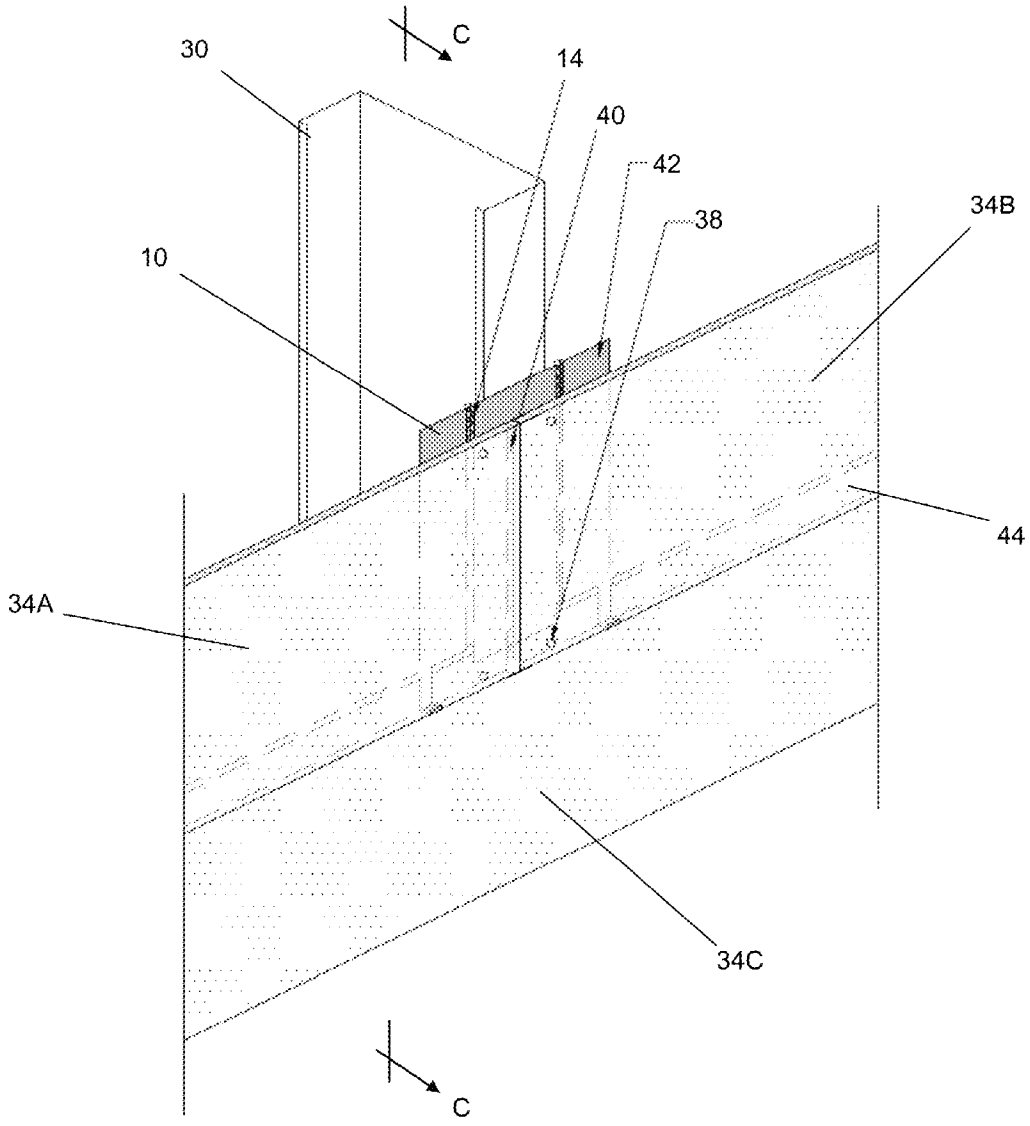


FIG. 4

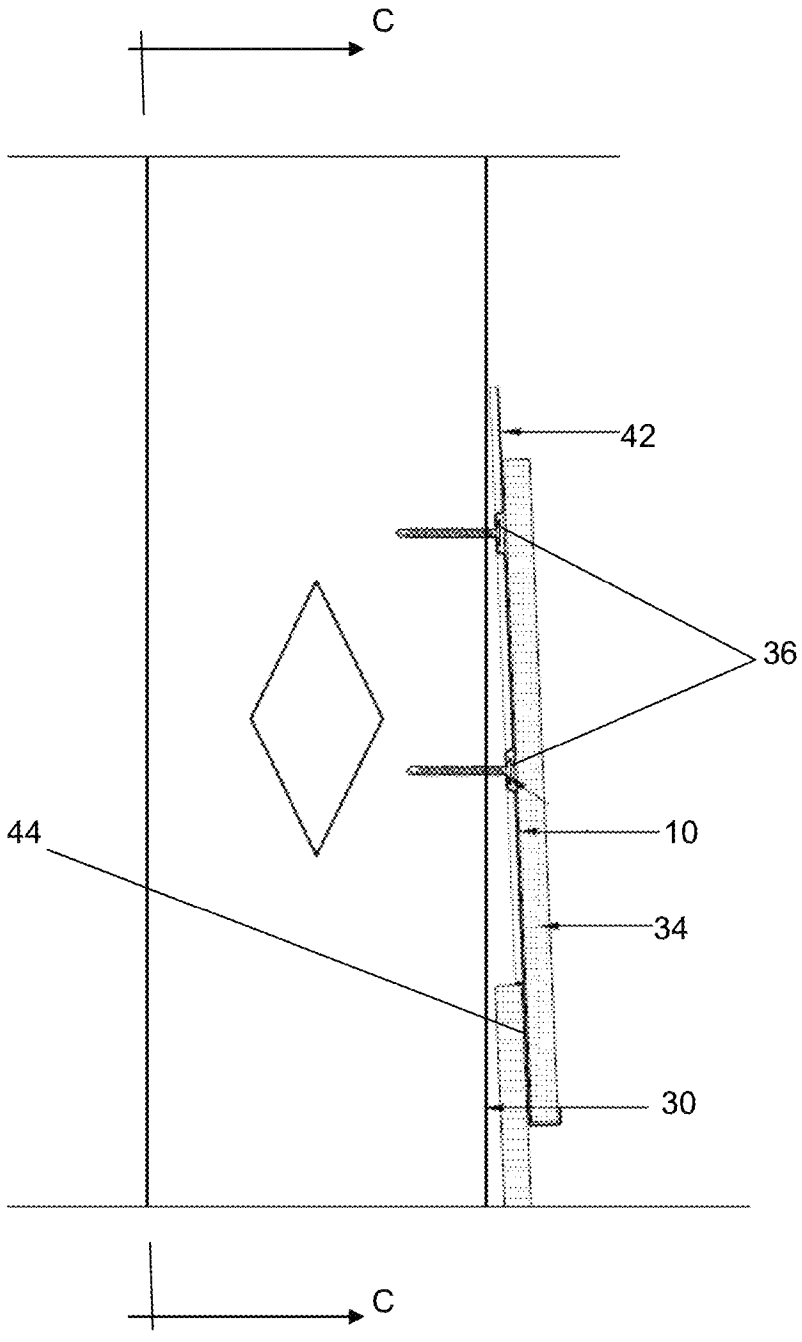


FIG. 5

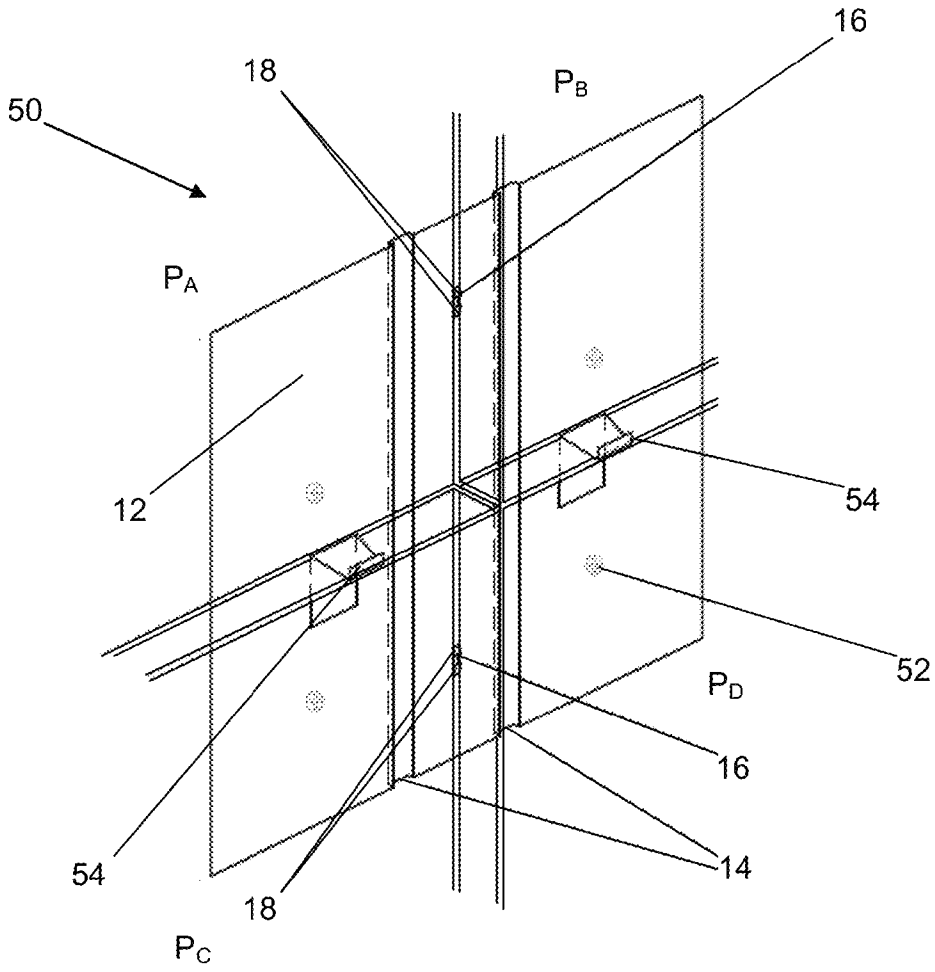


FIG. 6

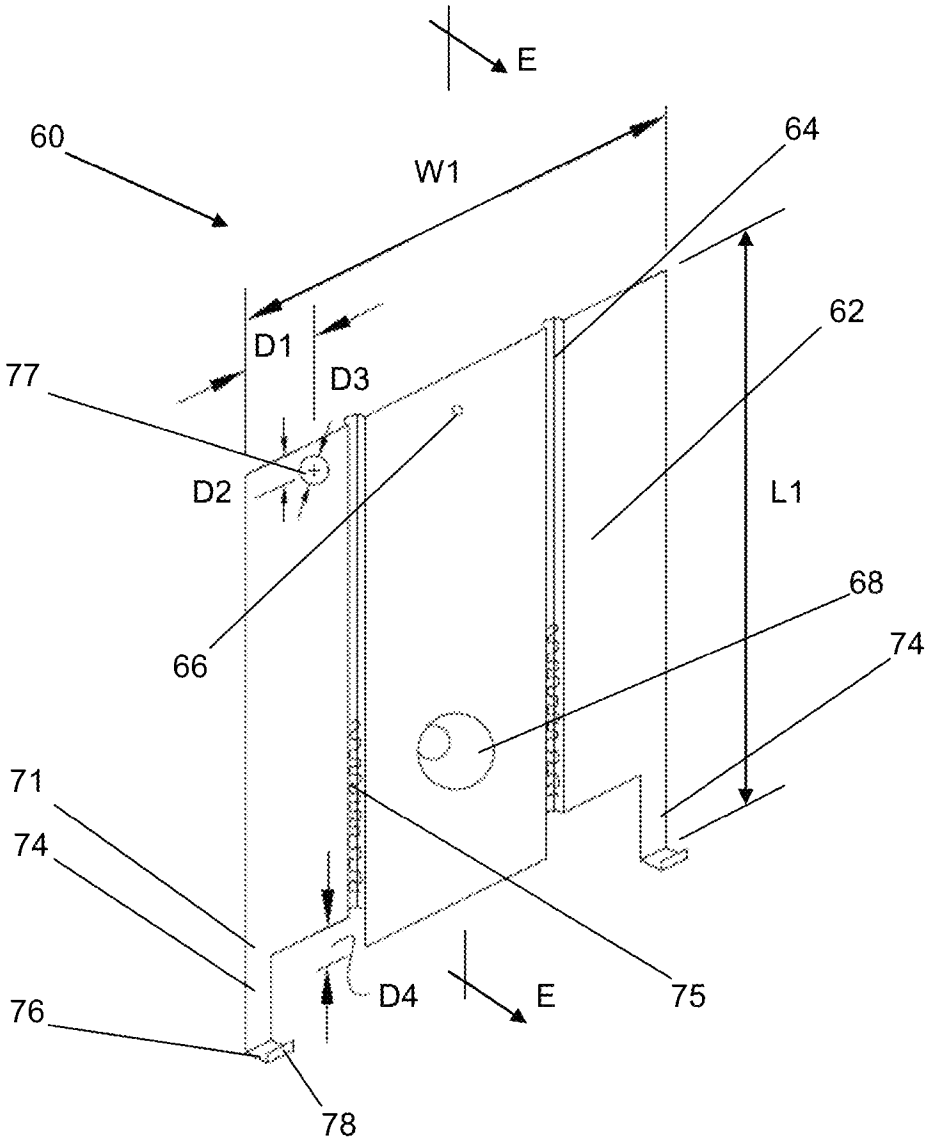


FIG. 7

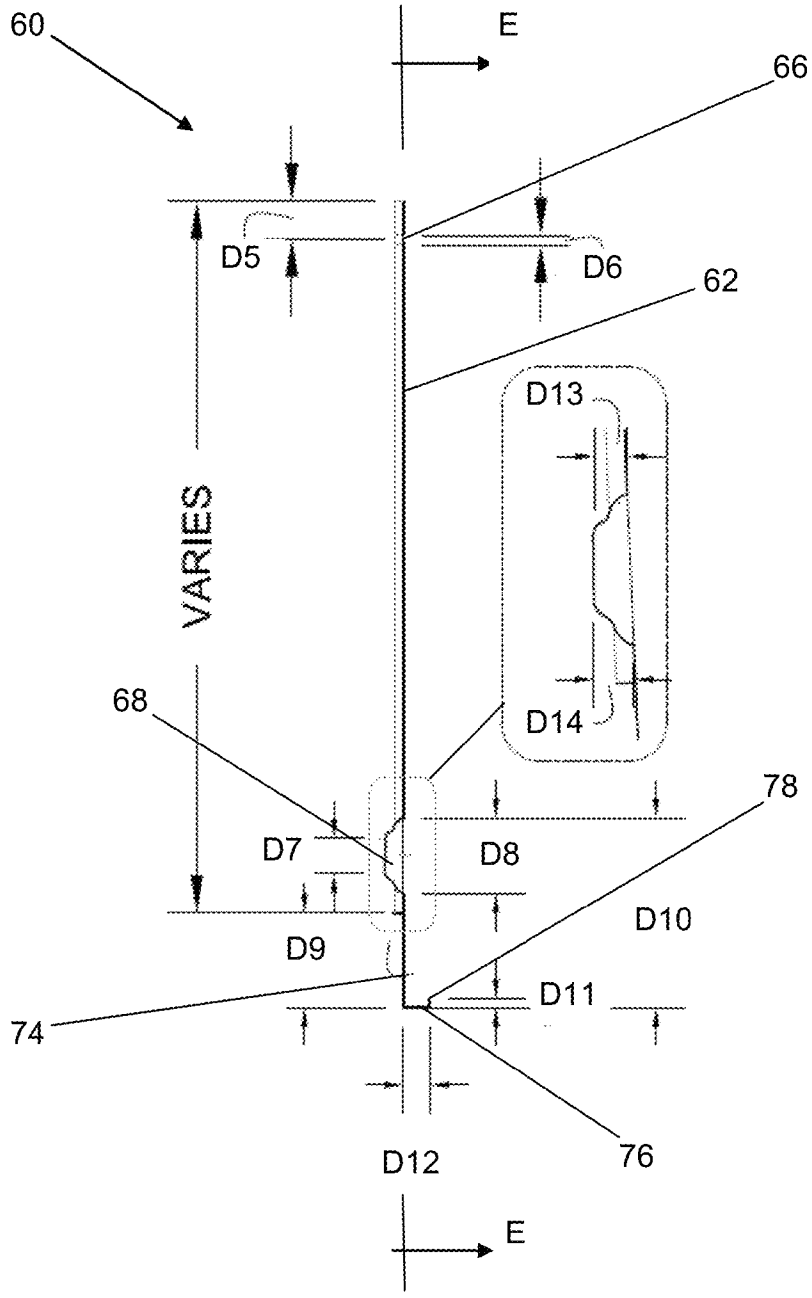


FIG. 8

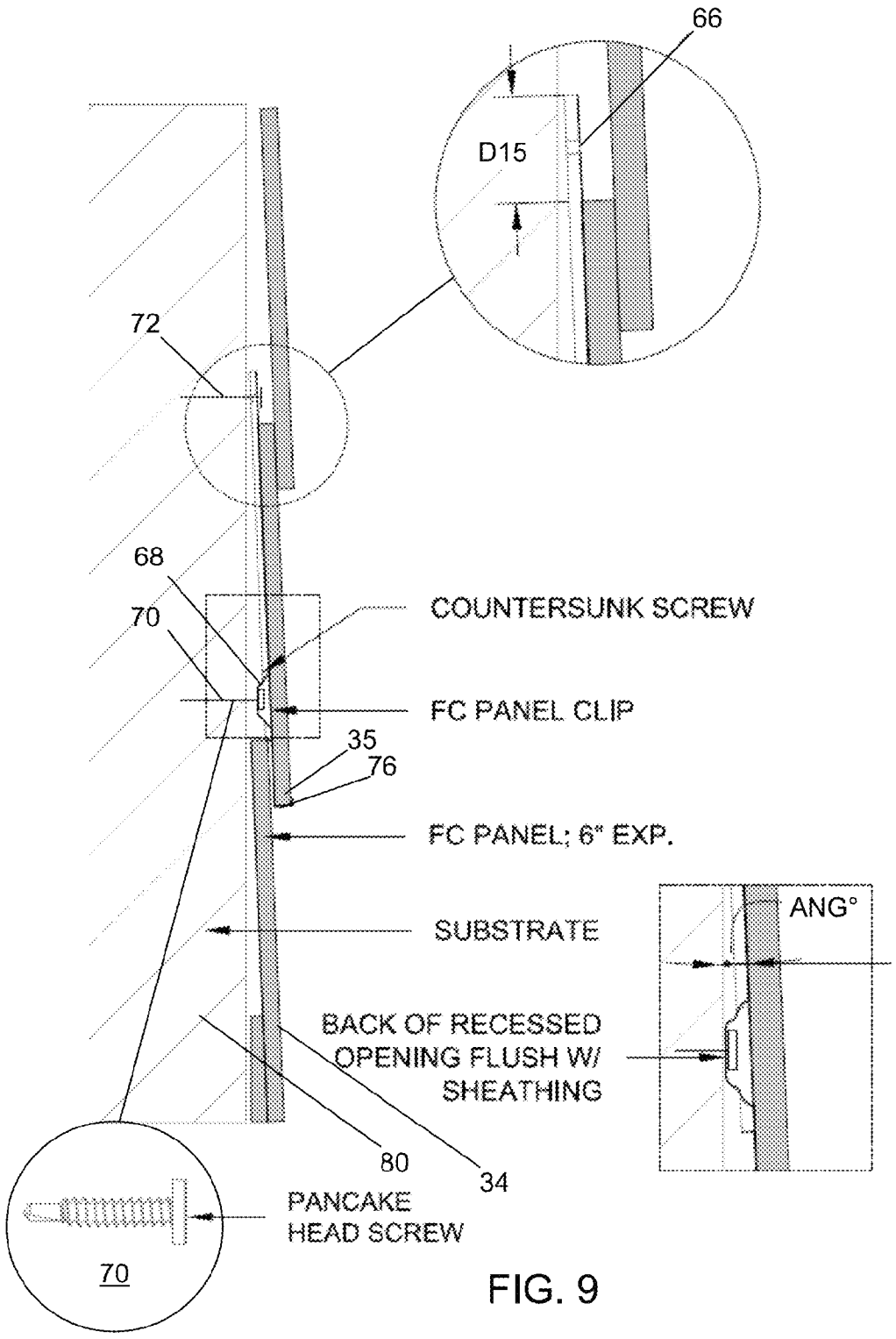

66
D15
72
68
70
COUNTERSUNK SCREW
FC PANEL CLIP
35
76
FC PANEL; 6" EXP.
SUBSTRATE
ANG°
BACK OF RECESSED
OPENING FLUSH W/
SHEATHING
80
34
PANCAKE
HEAD SCREW
70

FIG. 9

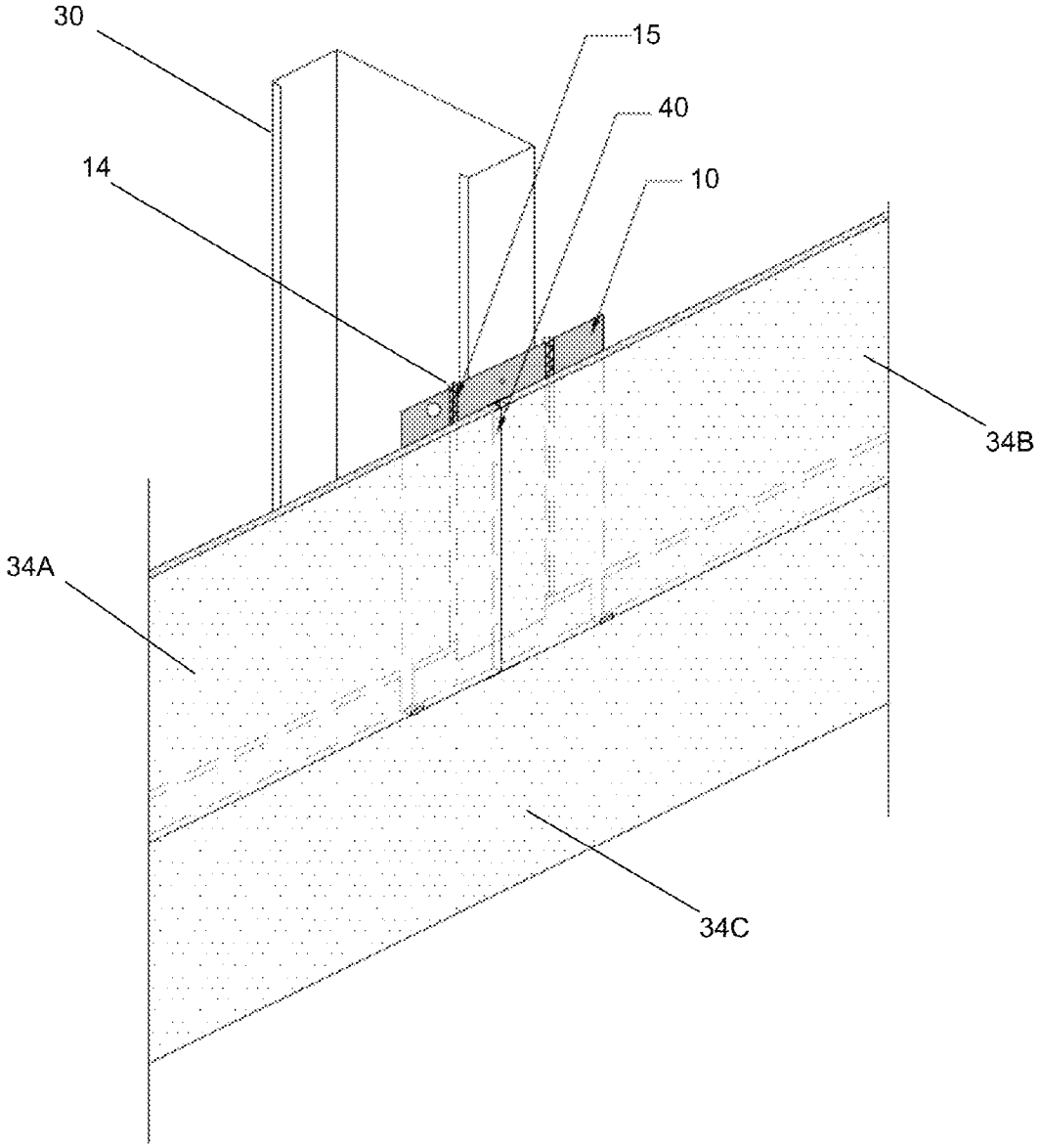


FIG. 10

JOINER CLIP

RELATED APPLICATIONS

This application claims priority benefit of U.S. Provisional Application Ser. 61/670,863 filed Jul. 12, 2012; and of U.S. Provisional Application Ser. 61/758,976 filed Jan. 31, 2013; the contents of which are hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention in general relates to an apparatus for installing and securing panels to a frame and in particular to a joiner plate or clip designed to address framing that is not planar, and for securing thin, brittle, and fragile panels that are prone to fracture during installation.

BACKGROUND OF THE INVENTION

Frame construction is a quick and efficient method of constructing inner and outer walls in structures. Frames generally are formed with vertical members called studs that are joined to upper and lower horizontal members.

Traditionally, studs were made of wood, usually 2'×4" or 2"×6" dimensional lumber. In North America, studs are typically placed 16 inches from each other's center, but sometimes also at 12 inch or 24 inch intervals. Steel studs are gaining popularity, especially for non load-bearing walls. Typically, panels, siding or other types of wall materials and sheeting are secured to the frame via screws, nails, or other specialty fasteners to the studs. However, non-planar framing may result in stress cracks and uneven or bowed surfaces in the joined panels, siding or other wall materials.

Fiber cement (FC) siding most often includes overlapping horizontal boards, imitating wooden siding, clapboard and imitation shingles, or large panels simulating tongue and groove or board and batten applications. Fiber cement siding is also manufactured in a sheet form and is used not only as cladding but is also commonly used as a soffit/eave lining and as a tile underlay on decks and in bathrooms. Fiber cement siding is not only used as an exterior siding, it can also be utilized as a substitute for timber fascias and bargeboards, especially in high fire risk or prone areas.

Siding or cladding materials, due to the material cost or manufacturing methods, are often thin and typically brittle or fragile. The thin nature of siding and cladding materials results in the siding materials conforming to the planar conditions of the framing. This can result in building stress into the applied panel. In addition to fiber cement, thin panels may be formed from laminated and composite wood materials, and panels formed from polymer resins. Siding materials can also be formed from steel, aluminum and ultra violet light resistant polyvinyl chloride. Despite the fragile nature of the aforementioned siding materials, attachment studs with widths that typically range from between 1¼-inch to 2-inches provide a very small 'target' to match and align the butt ends of the panels formed from the siding materials. With thicker, less brittle panels, such as cedar siding, a nail or screw can be installed at an angle into the stud, minimizing the problems created by the narrow stud; however, this cannot be done consistently with thinner and brittle panels. When securing to steel studs, the screw cannot be installed at an angle. The screw must be installed perpendicular to the stud to effectively penetrate the steel stud. A screw installed at an angle will not cut or pierce the steel to penetrate the section of steel. Also, if a stud is out of alignment or the panel has been mis-cut, there is insufficient bearing for the two panels to be secured to a single stud. The problem is compounded by the thin nature of the panel and the need for the head of the fastener to be flush with the surface of the panel, which requires the use of a countersunk head screw, typically with 'burrs' or 'wings' under the head to bore into the relatively hard and brittle panel to sink the head flush with the panel surface. The boring weakens the panel at a critical point since the butt edge attachment is very close to the edge.

The problems associated with the thin and brittle nature of certain panels are compounded when attached to a series of studs in a frame that are not planer. When a stud is not planer to panel, there is additional stress as two adjoining panel members are forced into alignment, which creates stress at both panel edges of the adjoined panels. Furthermore, even if a stud is planer to the outer face, the face of the stud can be damaged creating a point of attachment that is out of plane. By loading the end of the panel and drawing the panel out of plane, the panel will, over time, likely crack due to the loads created by pushing or pulling the panel to the misaligned stud. If the butt end of the panel is supported by the stud by only a fraction of an inch (a common occurrence) the nail or screw must be installed at an angle, creating further stress on the panel and resulting in cracking. Where wood studs are used, fasteners may be installed at angles to compensate for misalignment. However, for studs that are steel or made of composite materials, fasteners must enter perpendicular to the point of attachment to allow the fastener to drill or penetrate the substrate material.

Finally, to accommodate for material expansion, panel manufacturers often require gapping of the panels of approximately ⅛-inch or moderate contact of the edges. The expansion gap between panels further reduces the area on a panel for attachment to a stud, which creates greater problems achieving an adequate surface for attachment. For a perfect 'marriage' of the butt ends, the panel ends must be cut perfectly at a ninety degree angle in the field, which is not always achieved creating a gap between the two panel edges, again reducing the target area of attachment. The reduced area available for attachment requires screw head sizes that must be smaller to minimize the area of 'boring' into the panel surface to set the screw flush. Since the screw must be a minimum distance offset from the panel edge, the size of the screw head must remain small. Typical screw head sizes are 0.330 to 0.400-inches.

Thus, there exists a need for a joiner plate or clip that assists in installing and securing panels to a frame and is designed to address framing that is not planar, and for securing fragile panels that can be fractured during installation.

SUMMARY OF THE INVENTION

A joiner clip for securing panels to a substrate is provided that includes a planar sheet of material that has a bottom portion terminating in outer edges. A pair of legs extends downward from the outer edges and terminating in a retaining shelf clip adapted to support a bottom edge of an inserted panel. Mounting holes form countersunk indents in the planar sheet that offsets the joiner clip from the substrate. A construction unit is also provided has such a joiner clip secured to a vertical stud substrate. At least inserted panel is supported in the retaining shelf clip of a first leg of the clip. A joint is readily formed between two inserted panels. Fasteners through an inserted panel secure the same to the clip and substrate. An additional siding strip is readily secured to the substrate below the pair of legs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of an embodiment of the joiner plate;

FIG. **2** is a schematic diagram illustrating a cross sectional view of the embodiment of the joiner plate of FIG. **1** along line A-A;

FIG. **3** is a perspective view of the embodiment of the joiner plate of FIG. **1** that is attached to a stud through a sheet of sheathing material;

FIG. **4** is a perspective view of the embodiment of the joiner plate of FIG. **1** that is attached to directly to a stud;

FIG. **5** is a sectional view of the embodiment of the joiner plate of FIG. **4** along line C-C showing pancake head fasteners securing the plate to a stud;

FIG. **6** is a perspective view of an additional embodiment of the inventive joiner plate;

FIG. **7** is a perspective view of an embodiment of a joiner plate or clip for fiber cement (FC) cladding or panels;

FIG. **8** is a schematic diagram illustrating a cross sectional view of the embodiment of the joiner plate or clip of FIG. **7** along line E-E;

FIG. **9** is a perspective view of the embodiment of the joiner plate or clip of FIG. **7** that is attached to a substrate to support fiber cement panels; and

FIG. **10** is a perspective view of the embodiment of the joiner plate of FIG. **1** that is attached directly to a stud and the panels are secured to the joiner plate with an adhesive without the use of thru panel fasteners.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention has utility as a joiner clip to form a construction unit that assists in installing and securing panels to a frame and is designed to address framing that is not planar, as well address issues related to securing fragile panels that can be fractured during installation. As used herein, the terms "joiner plate" and "joiner clip" are used synonymously. Embodiments of the inventive joiner plate or clip increase speed in panel or siding installation by minimizing re-cutting due to variations in studs and provides for a bearing surface to receive sealant beads to enhance bonding of the cladding panels and to direct waterflow at the panel joints to the outer face of the cladding. In certain embodiments, an extended lip at the bottom of the joiner plate eliminates the need for a flashing membrane or flat metal plate behind a panel edge joint to direct any incidental water that enters the joint to a building exterior. Embodiments of the inventive joiner plate may be used for substrates such as wood, metal, alloy, and steel studs.

It is to be understood that in instances where a range of values are provided that the range is intended to encompass not only the end point values of the range but also intermediate values of the range as explicitly being included within the range and varying by the last significant figure of the range. By way of example, a recited range of from 1 to 4 is intended to include 1-2, 1-3, 2-4, 3-4, and 1-4.

Embodiments of the on-stud attachment joiner plate or clip provide for even support of panels with a broad attachment base. Embodiments of the on stud attachment joiner plate or clip are an improvement over existing off-stud joiners that slip on a panel below and only provide approximate 2 to 2½-inch bearing surface for attachment of a panel. The broad attachment base allows for a reduction in the number of joiner plates or hangers for a given length of panel, thereby requiring less labor and installation time. The broad attachment base provided by embodiments of the inventive joiner, in contrast to the thinner attachment surface of a traditional stud, allows for an increased screw head size (versus traditional sizes in the range of 0.330 to 0.400-inches). A pancake head screw with a head diameter of 0.450 to 0.700-inch can be used without the requirement to bore the panel surface to create a flush installation. The larger screw head creates greater holding power (rupture over the panel) and a greater wind load resistance with a single fastener. The reduction in the number of screw fasteners contributes to less potential damage to the panel, and saves time and labor with less fastening. The joint between the joiner plate and panel is fully supported to eliminate stress and cracking at the panel connection point, while also providing adequate securement to meet any wind load requirements.

The inventive joiner plate acting as an attachment or bearing plate for panels can be attached to a stud with one or two screws, depending on the size of the panels and the wind load requirements for the project. From an aesthetic point of view, the larger area of attachment also allows the installer to create an even pattern of joiner plate attachments instead of forcing fasteners in at the corners that are not pleasing.

Furthermore, the broad attachment area of the inventive joiner plate allows for screws or other fasteners to always be installed perpendicular to the joiner plate steel. The screw will enter the joiner plate without skidding, and will create maximum holding power while not stressing the panel. Attachment at extreme edges of the panel that weakens the panel with traditional studs is eliminated with the inventive joiner.

The joiner plate provides a bottom-supported connection with tabs for panels that aligns the panel both horizontally and vertically. The panel is properly aligned, vertically, by the support tabs at the bottom of the joiner plate and a 'drip lip' alignment tab that rests on the top of the panel below. The drip lip aligns the panel and acts as a drip over the panel below. The drip lip also secures the top of the panel providing additional wind resistance. The tabs perfectly align the panels and assist to hold the panel in place prior to attachment of the panel to the plate. The somewhat flexible tabs will, once the screw penetrates the steel of the plate, draw the panel to the plate and the joiner plate to the panel. This assists in reducing stress when a stud is out of alignment and creates a larger bearing surface at the back of the panel to create greater support.

The flat face of the joiner plate creates an excellent surface to mate the two panel edges. The outer edges and surfaces of the joined panels will always be in plane, eliminating shadow lines, voids, and out of plane edges. The joining plate can be formed in various sizes to address any size lap panel with any predetermined overlap. The joining plate can also be used in flat panel siding to create a bearing surface at the transition of four separate panel corners. Embodiments of the joining plate can also be modified at panel siding to accommodate reveals and gapped panels. The joining plate can be pre-colored to match pre-painted siding, or can be formed from paint grip or bonderized metal that will easily take paint. The gauge or thickness of joiner plate can be reduced by adding stiffening ribs running perpendicular with the studs.

Embodiments of the joiner plate can adjust to accommodate minor planar stud deviations in the frame support with 'control drive' fins formed on the back of the planar portion of the joiner plate, which allow an installer to set the depth of the on-stud attachment joiner plate to maintain a planar condition at the finished side of the attached panels or siding. The back fins at point of attachment to the stud allow for a controlled drive. The joining plate can be offset to compensate for a stud that is out of plane. This coupled with the flexible control drive fins of the plate provide substantial compensation for a stud out of plane. The correction of minor stud deviations reduces load protection and therefore stress on attached panels such as cement panels. The joiner plate does not need to be perfectly aligned on the stud, since the large bearing surface

creates room for adjustment. Attachment of the joiner plate is low enough to avoid interference with the upper panel. Furthermore, embodiments of the joiner plate are thin enough to 'move' to create a snug connection with panels including fiber cement, yet strong enough to transfer the load through the fastener to the steel or wood stud, thereby creating an immediate correction. The use of pancake head screws to secure embodiments of the joiner plate improves attachment with a larger bearing surface since the screws can be placed lower on the joiner plate and away from edges of the plate. The pre-alignment options of embodiments of the joiner plate speed installation of the attached panels or siding.

Embodiments of the inventive joiner plate may also have provisions for joint flashing, providing weather proofing of the joint. In an embodiment, the joiner plate or clip acts as waterproofing flashing at joints of panels formed from a fabric flashing or a flat metal plate. In some embodiments, sealant channels create additional weather proofing and additional securement at the panel or siding attachment interface when the sealant is also an adhesive. The sealant channels can be arranged to be at the points of attachment, which will seal the fastener opening. The sealant channels in the joiner plate create a sealing line, keeping any water that enters the butt joint of a secured panel from traveling to a lower panel top edge or to a weather resistive barrier. Sealant may be pre-applied as a sealant strip with release paper to protect the bonding surface to speed installation. The back of the joining plate can be thermally broken to minimize thermal transfer through the plate. The sealant may also be used as an adhesive to eliminate nails or screws. Since the cladding or siding has been locked into the tabs providing alignment or support the cladding or siding can be adhered to the joiner plate creating a larger, more effective form of attachment without point loading.

Embodiments of the joiner plates or clips may also be installed at each stud, providing support for the cladding or siding from below and again at the top, securing the top edge with the drip lip. No fasteners are required through the cladding or siding at any point. The cladding or siding is secured by support of the tabs below, compression of the flashing tab and the sealant applied in the sealant channels as a sealant bead.

With reference to the attached figures, an inventive joiner plate or clip is depicted generally at **10** in FIG. **1**. The joiner plate **10** is typically formed from a planar sheet composed of metal; metal alloys; plastic; fiber reinforced resins of fiberglass or carbon fiber; or other composite materials. In an embodiment the joiner plate **10** may be formed from 16 gauge to 26 gauge, G-90 galvanized or 55% Aluminum-Zinc alloy coated sheet steel known as GALVALUME® metal, or 16 gauge to 26 gauge galvanized paintgrip/bonderized for painting of the joiner plate surface. The joiner plate **10** has a flat face **12** in which channels **14** for holding an optional sealant or an adhesive based sealant beads **15** are formed. Mounting holes **16** are pressed into the flat face **12** with the excess material forming vertical indent tabs in the form of control drive fins **18**. The control drive fins **18** are adjustable to create planar conditions for attaching panels in the event the studs are uneven. In an installation, as a screw is driven into the flat face **12** (see FIG. **5**), the control drive fins determine how tight the joiner plate **10** is held to the stud **30**. In an embodiment, the control drive fins **18** are a quarter of an inch (0.25 inch) length, thereby providing the ability to adjust up to 0.25 inch for correcting for the relative planarity between the studs. As shown in FIG. **5**, screws **36** may be pre-set in the mounting holes **16**. In an inventive embodiment, number ten (#10) pancake head screws are countersunk and flush with the vertical flat face **12** of the joiner plate **10**, where the head of the screws **36** have approximately the same outer diameter as the mounting holes **16**. The (#10 or #12) pancake head screws provide a minimum withdrawal resistance in 33 KSI 24 ga. galvanized steel of not less than 2251bf.

Continuing with FIGS. **1** and **2**, the lower portion **21** of the joiner plate **10** has a pair of forward facing legs **20** extending down on the right and left sides of the joiner. Forward facing legs **20** has a fold **22** that abuts a perpendicular segment **24**. It is appreciated that the legs **20** are integral with the plate **10** or formed separately and subsequently joined thereto. While the legs **20** are depicted as a pair with each positioned proximal to a lower corner edge of the joiner plate **10**, it is appreciated that one or more intermediate legs are providing in the space between these bounding legs **20** so depicted. Perpendicular segment **24** terminated in lip segment **26** acts as a retaining shelf for a panel. Thus the joiner plate **10** supports a panel with both concealed screws **36** and the retaining shelf acting as a "turn-up" support clip or tab at the base of the joiner plate **10**. The tabs provide support and align the fiber cement panels. The exterior or exposed face of tabs that appear as lip segment **26** are large enough to support the siding, but small enough so that the lips **26** are not easily seen. The overall width (W) of the joiner plate **10** as shown in FIG. **1** may range between 4 to 6 inches thereby providing a broad attachment base that allows for a reduction in the number of joiner plates or hangers for a given length of panel, thereby requiring less labor and installation time. The 3.5 to 5.5 inch space between the legs **20** creates a wide point at attachment, keeping lap panel attachment away from edges, and eliminating cracking of corners. In other embodiments the space is 3 to 6 inches between the legs **20**.

FIG. **3** is a perspective view of the embodiment of the joiner plate **10** of FIG. **1** that is attached to a stud **30** through a sheet of sheathing material **32** such as gypsum with a fiber cement siding **34**. Additional siding **34** may be inserted into legs **20**. The color of the joiner plate **10** may match the color of the siding **34** if painted.

FIG. **4** is a perspective view of the embodiment of the joiner plate **10** of FIG. **1** that is attached to directly to a stud **30** with siding **34** arranged in an over lapping fashion (lap siding) with a butt joint **40** between the span of the joiner plate **10** separating siding pieces **34**A and **34**B. It is appreciated that other joint types are also operative herein and these other joint types illustratively include rabbet joints, miter joints, splice joints, spline joints and dovetail joints. Siding pieces **34**A and **34**B overlaps siding strip **34**C in region **44**, with siding pieces **34**A and **34**B resting in legs **20** of the joiner plate **10**. Panel attachment holes **38** accommodate a fastener to secure the siding panel to the plate **10**, such as a thru panel #10 type fastener. As shown the joiner plate **10** optionally may extend beyond the top of a panel the joiner plate **10** is supporting as shown as region **42**. FIG. **5** is a sectional view of the embodiment of the joiner plate of FIG. **4** along line C-C showing pancake head fasteners **36** securing the plate **10** to the stud **30**.

FIG. **6** is a perspective view of an additional embodiment of the inventive joiner plate for securing four corners from four independent panels P_A, P_B, P_C, P_D (shown in a transparent outline) in a non-overlapping arrangement. The joiner plate **50** is typically formed from a planar sheet composed of metal, alloys, plastic, or other composite materials. In an embodiment the joiner plate **50** is 16-26 gauge, G-90 galvanized metal or 16-26 gauge galvanized with paintgrip or bonderized coating. The joiner plate **50** has a flat face **12** in which channels **14** for holding an optional sealant or an adhesive based sealant are formed. Stud mounting holes **16** are pressed into the flat face **12** with the excess material forming

vertical indent tabs in the form of control drive fins **18**. The control drive fins **18** are adjustable to create planar conditions for attaching panels in the event the studs are uneven. In an installation, as a screw is driven into the flat face **12** (see FIG. **5**), the control drive fins determine how tight the joiner plate **50** is held to the stud (not shown). In an embodiment, the control drive **18** are a quarter of an inch (0.25 inch) length, thereby providing the ability to adjust up to 0.25 inch for correcting for the relative planarity between the studs. In an embodiment number ten or twelve diameter pancake head screws countersunk and flush with the vertical flat face **12** of the joiner plate **50**, where the head of the screws **36** have approximately the same outer diameter as the mounting holes **16**. The pancake head screws provide a minimum withdrawal resistance in 33 KSI in galvanized steel of 225 lbf. Thru-panel fasteners **52** may also be (#10) pancake head screws that secure the four corners of the four independent panels P_A, P_B, P_C, P_D to the joiner plate **50**. Punch tabs **54** are formed from the flat face **12** of joiner plate **50**. The punch tabs **54** act as positioning retaining shelves for holding panels P_A, P_B prior to their securement with thru-panel fasteners **52**. In an embodiment the joiner plate may be a square with 6 inch sides.

An inventive fiber cement (FC) fiber cement joiner plate or clip is depicted generally at **60** in FIG. **7**. The joiner plate and clip **60** is typically formed from a planar sheet composed of metal, alloys, plastic, or other composite materials. In an embodiment the joiner plate and clip **60** is 16-26 gauge in thickness, G-90 galvanized or GALVALUME® metal or galvanized paintgrip/bonderized. The joiner plate and clip **60** has a flat face **62** in which channels **64** for holding an optional sealant or an adhesive based sealant **75** are formed. Mounting holes **66** and **68** are pressed into the flat face **62**. Mounting hole **66** is an aperture positioned in the upper center lime portion of the joiner and clip **60**, while mounting hole **68** is a circular countersunk indent with a predrilled hole or aperture.

As shown in FIG. **9**, a countersunk screw **70** may be pre-set in the circular countersunk indent **68**, and screw **72** is inserted through aperture **66**. In an embodiment number ten (#10) pancake head screws are countersunk and flush with the vertical flat face **62** of the joiner plate and clip **60**, where the head of the screws **70** and **72** have approximately the same outer diameter. The (#10 or #12) pancake head screws provide a minimum withdrawal resistance in 33 KSI 24 ga. galvanized steel of not less than 225 lbf. A pancake screw does not interfere with succeeding panels.

Continuing with FIGS. **7** and **8**, the lower portion **71** of the joiner plate and clip **60** has a pair of legs **74** extending downward on the right and left sides of the joiner plate and clip **60**. A right angled segment **76** or foot extends from the leg **74** and terminates with upward segment or lip **78** that acts as a retaining shelf for a panel, such as a fiber cement (FC) panel. Thus the joiner plate and clip **60** supports a panel with both concealed screws **70** and **72**, and the retaining shelf acting as a "turn-up" support clip at the base of the joiner plate and clip **60**. In an embodiment, the center of the clip extends down one half inch (0.50") to form a drip lip. This drip lip aids with alignment and panel support acts as a drip over the panel below. The overall width (W**1**) of the joiner plate and clip **60** as shown in FIG. **7** may range between 4 to 6 inches thereby providing a broad attachment base that allows for a reduction in the number of joiner plates or hangers for a given length of panel, thereby requiring less labor and installation time. In an embodiment W**1** is five inches. The 3.5 to 5.5 inch space between the legs **74** creates a wide point at attachment, keeping lap panel attachment away from edges, and eliminating cracking of corners especially for FC siding. Carrying hook hole **77** is provided for ease of transport by a workman during an installation of panels at a worksite. In an embodiment hole **77** has a three eights inch (⅜") inch diameter and is positioned one inch (1.0") D**1** in from the upper left corner and centered three eights inch (⅜") D**2** down.

FIG. **9** is a perspective view of the embodiment of the joiner plate and clip **60** of FIG. **7** that is attached to a substrate **80** and supports siding sheets such as fiber cement siding panel **34** that has a bottom portion **35** that is held under the right angled segment **76** or foot that extends from the leg **74** and terminates with upward segment or lip **78**. The color of the joiner plate and clip **60** may match the color of the siding **34** if painted. Circular countersunk indent **68** provides a standoff from the substrate **80** that creates an angled placement (ANG°) of the siding, and for an overlapping placement of the siding **34**. In an embodiment there is a two degree angle (ANG°) between the substrate **80** and the back of the clip **60**. In an embodiment, the circular countersunk indent **68** is one inch wide punched area with an eighth (⅛") of inch drilled hole. The length of the vertical leg **74** and overall length (L**1**) varies depending on the required exposure of the panel. In an embodiment the clip extends one inch above the panel that the clip supports, as shown as dimension D**15** in detail A of FIG. **9**.

FIG. **10** is a perspective view of the embodiment of the joiner plate **10** of FIG. **1** that is attached directly to a stud **30** and the panels **34**A, **34**B, and **34**C are secured to the joiner plate with an adhesive without the use of thru panel fasteners. No fasteners are required through the cladding or siding at any point, thereby guarantying the integrity of brittle panel materials. The cladding or siding is secured by support of the tabs below, compression of the flashing tab and the sealant **15** applied in the sealant channels **14**.

Any patents or publications mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication was specifically and individually indicated to be incorporated by reference.

The foregoing description is illustrative of particular embodiments of the invention, but is not meant to be a limitation upon the practice thereof.

The invention claimed is:

1. A joiner clip for securing panels to a substrate comprising:

a planar sheet of material, having a bottom portion, the bottom portion having outer edges;

a pair of legs extending downward from the outer edges of the bottom portion of said planar sheet, said pair of legs terminating in a retaining shelf clip adapted to hold a bottom edge of an inserted panel;

a first mounting hole in a countersunk indent of said planar sheet that offsets the joiner clip from the substrate;

a second mounting hole in said planar sheet; said first mounting hole and said second mounting hole sized to accommodate fasteners for attaching the joiner clip to the substrate; and

one or more control drive fins on a back side of said planar sheet for compensation for portions of the substrate that are out of plane.

2. The joiner clip of claim **1** further comprising one or more channels for accommodating a sealant bead.

3. The joiner clip of claim **2** wherein said pair of legs is integral with said planar sheet.

4. The joiner clip of claim **1** wherein said planar sheet of material is a metal, alloy, plastic, or fiber reinforced resin.

5. The joiner clip of claim **1** wherein said countersunk indent provides a standoff from said substrate that creates an angled placement of the inserted panel.

6. The joiner clip of claim 1 wherein said legs are spaced between 3.5 to 5.5 inches apart.

7. The joiner clip of claim 1 wherein said fastener is a pancake head screw that is countersunk and flush with a vertical flat face of said planar sheet, a head of the pancake head screw with a diameter that is larger than a lower portion of a chamfer of a countersink hole, and where the diameter of the head is less than the diameter of an upper portion of the chamfer of the countersink hole of said mounting holes.

8. The joiner clip of claim 1 wherein the inserted panel is fiber cement.

9. The joiner clip of claim 1 wherein said planar sheet is 16-26 gauge galvanized metal.

10. The joiner clip of claim 1 wherein said planar sheet is 55% Aluminum-Zinc alloy coated sheet steel.

11. The joiner clip of claim 1 wherein said planar sheet is galvanized paintgrip or galvanized bonderized.

12. The joiner clip of claim 2 wherein said planar sheet acts as a waterproofing flashing at a joint with said inserted panel forms a fabric flashing or a flat metal plate with said one or more channels for accommodating said sealant bead.

13. The joiner clip of claim 1 wherein said joiner clip is installed at both a top and a bottom of an inserted panel to eliminate the need for through-fastening of the inserted panel to the substrate.

14. The joiner clip of claim 1 wherein the substrate is a stud.

15. A construction unit comprising:

a vertical stud substrate;

a joiner clip for securing panels to the substrate comprising: a planar sheet of material, having a bottom portion, the bottom portion having outer edges; a pair of legs extending downward from the outer edges of the bottom portion of said planar sheet, said pair of legs terminating in a retaining shelf clip; a first mounting hole in a countersunk indent of said planar sheet that offsets the joiner clip from the substrate; a second mounting hole in said planar sheet; said first mounting hole and said second mounting hole sized to accommodate fasteners for attaching the joiner clip to the substrate; and one or more control drive fins on a back side of said planar sheet for compensation for portions of the substrate that are out of plane; and

an inserted panel supported by at least one of said pair of legs.

16. The unit of claim 15 further comprising a fastener extending through said inserted panel to said joiner clip.

17. The unit of claim 15 wherein said inserted panel is supported by only a first leg of said pair of legs and further comprising a second inserted panel forming a joint with said inserted panel and supported on a second leg of said pair of legs.

18. The unit of claim 15 further comprising a siding strip secured to said substrate beneath said inserted panel.

* * * * *

US006725610B2

(12) **United States Patent**
Murphy et al.

(10) **Patent No.: US 6,725,610 B2**
(45) **Date of Patent: Apr. 27, 2004**

(54) **WINDOW SEAL CONSTRUCTION**

(75) Inventors: **Colin Murphy**, Seattle, WA (US); **Robert Mills**, Seattle, WA (US); **Wei Lam**, Seattle, WA (US); **David Landsburgh**, Argyll (GB); **Charles Phillips**, Seattle, WA (US)

(73) Assignee: **Exterior Research, LLC**, Seattle, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 26 days.

(21) Appl. No.: **09/814,199**

(22) Filed: **Mar. 21, 2001**

(65) **Prior Publication Data**

US 2001/0034984 A1 Nov. 1, 2001

Related U.S. Application Data

(60) Provisional application No. 60/191,364, filed on Mar. 22, 2000.

(51) **Int. Cl.**[7] **E06B 7/00**; E06B 7/16; E06B 7/12; E04D 1/36

(52) **U.S. Cl.** **52/58**; 52/204.1; 52/204.5; 52/741.4; 52/745.15

(58) **Field of Search** 52/58–62, 97, 52/302.6, 204.1, 204.5, 741.4, 745.15

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Primary Examiner—Robert Canfield
(74) *Attorney, Agent, or Firm*—Carella, Byrne, Bain, Gilfillan, Cecchi et al; Elliot M. Olstein; William Squire

(57) **ABSTRACT**

A relatively high perm pliable moisture barrier material pliable sheet material exhibits a breathable perm value, e.g., over 0.4, that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of said wall at the opening while providing a water barrier to liquid water applied thereto is applied to corners of the window opening in a wall as a plurality of corner seals with leg portions for application to the face of sheathing and leg portions for overlying the sill, jambs and head of the opening at the corners. Flanges may be included for sealing the sheet material to an interior vapor barrier material. Sill, jamb and head seals are applied over the corner seals and over the sill, head and jambs to completely seal the window opening with the sheet material. Weather resistant barrier material is then applied over or under the seals as are conventional metal flashing and sealant beads. Pinholes are substantially eliminated. A retrofit arrangement including corners, sill, jamb and head strips are bonded to the sheathing and to the frame without removing the window and which seals form a high perm continuous moisture seal about the window opening.

25 Claims, 12 Drawing Sheets

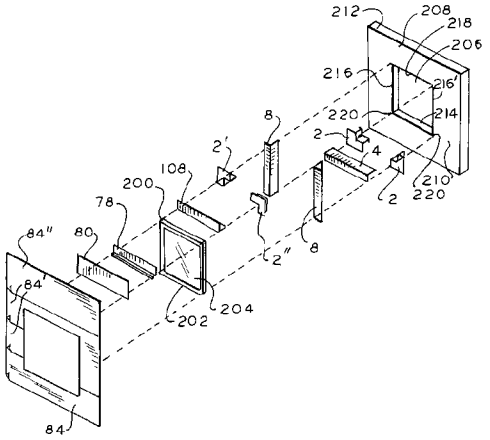

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FIG. 1
PRIOR ART

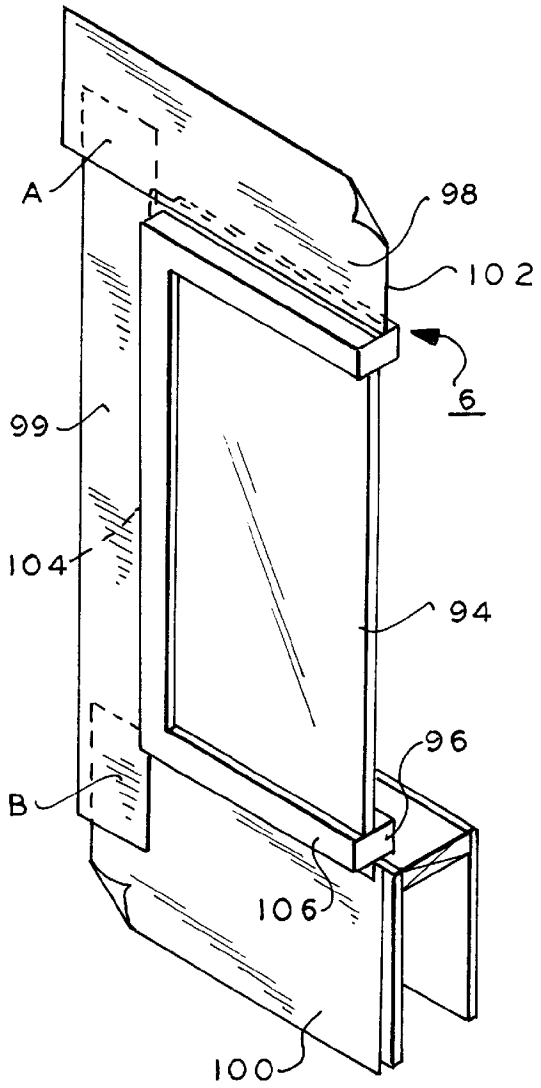


FIG. 5

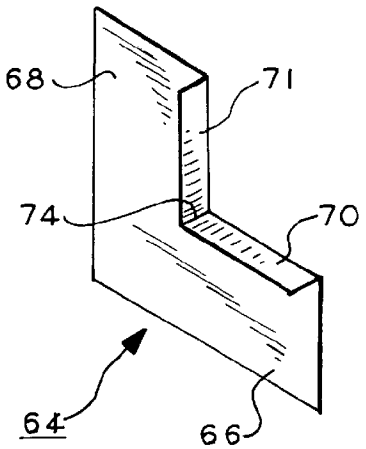
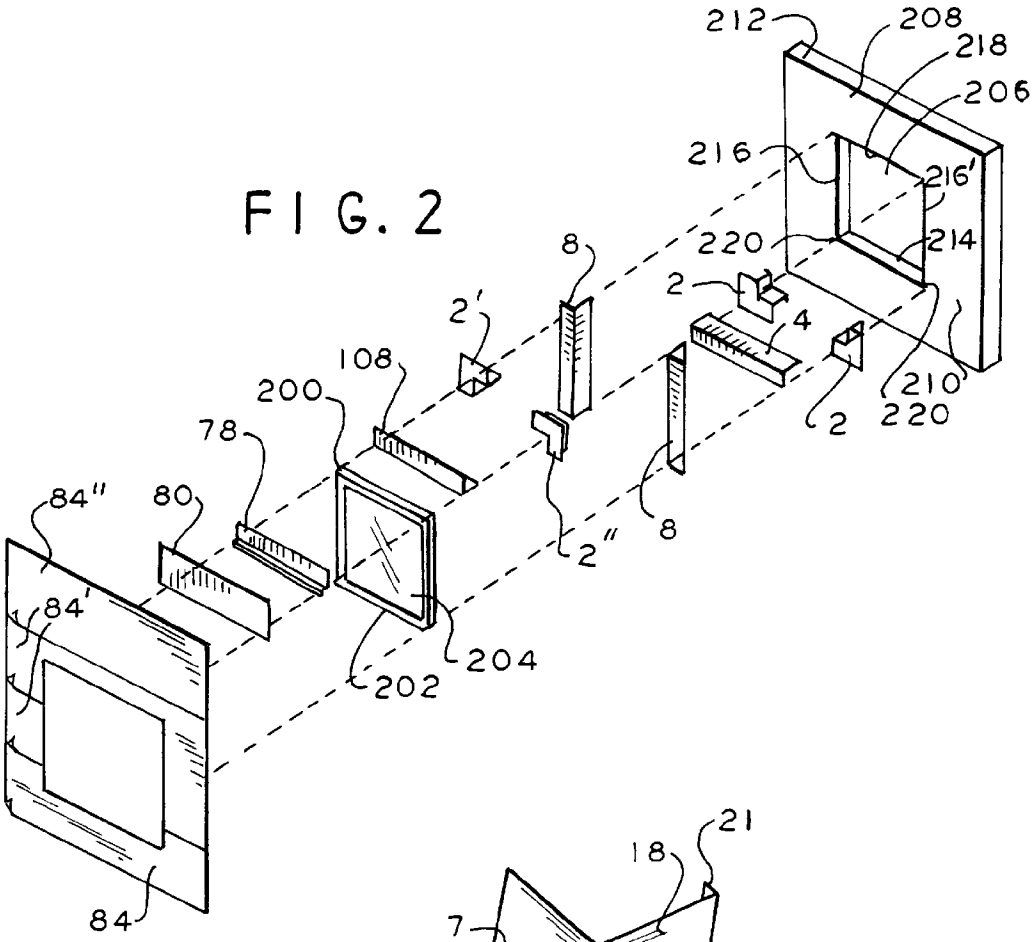


FIG. 2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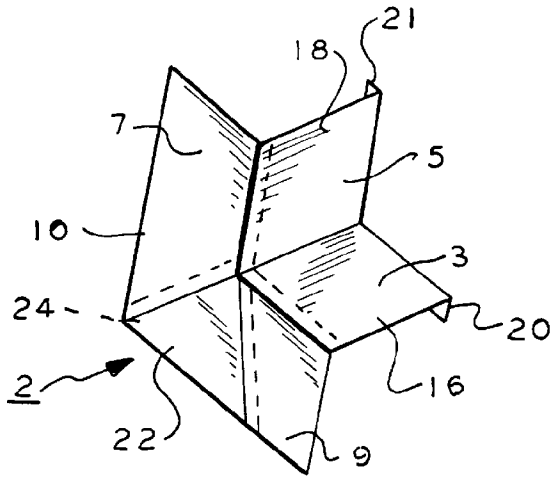
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FIG. 3

FIG. 3a

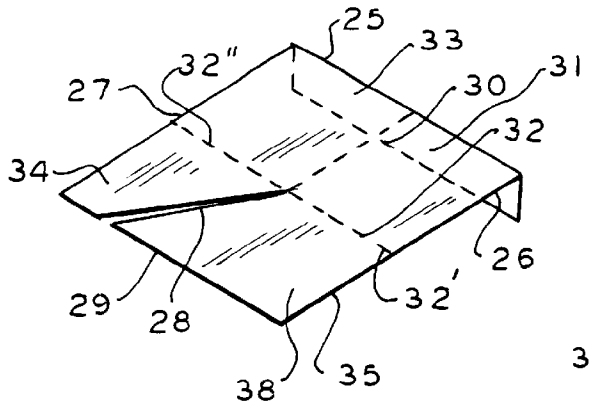

FIG. 3b

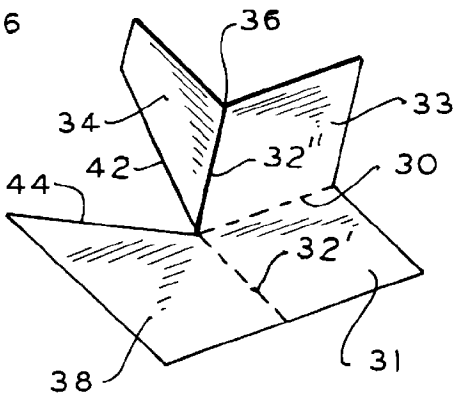

FIG. 3c

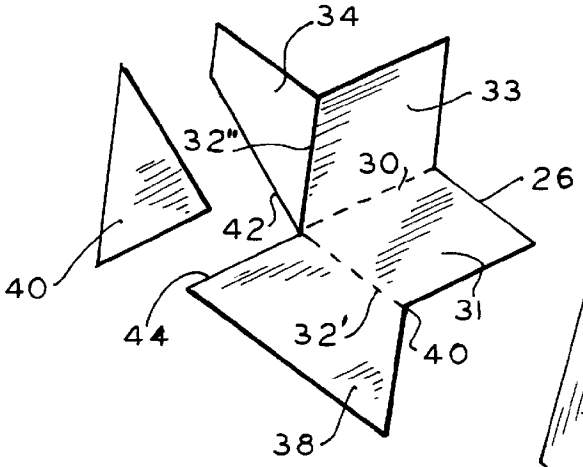

FIG. 4

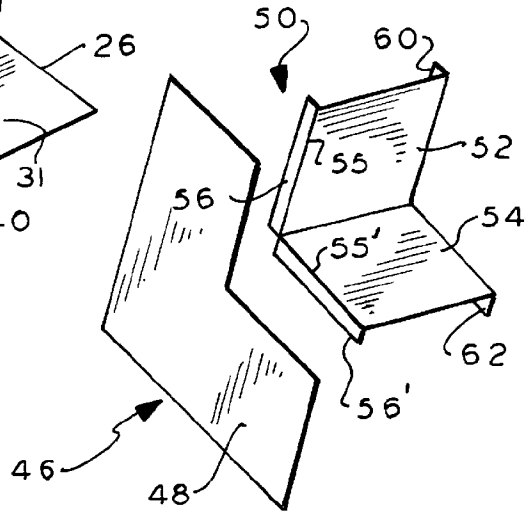

FIG. 6

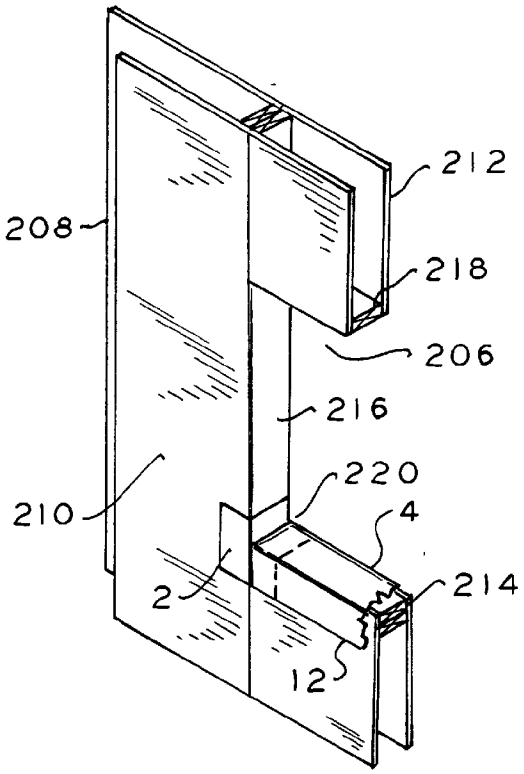
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FIG. 7

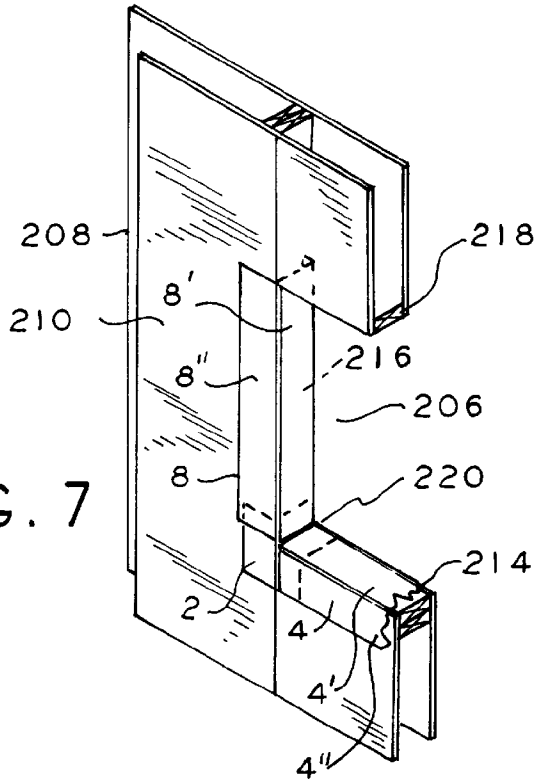
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FIG. 8

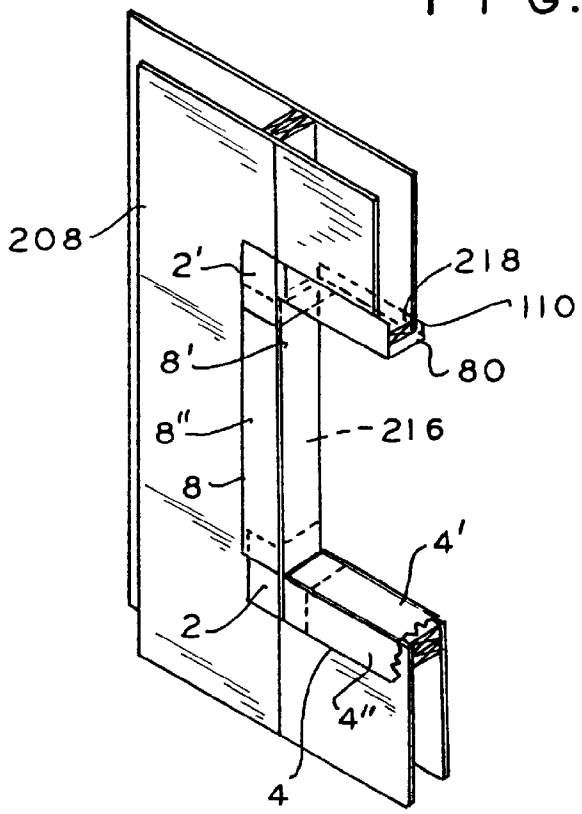


FIG. 13

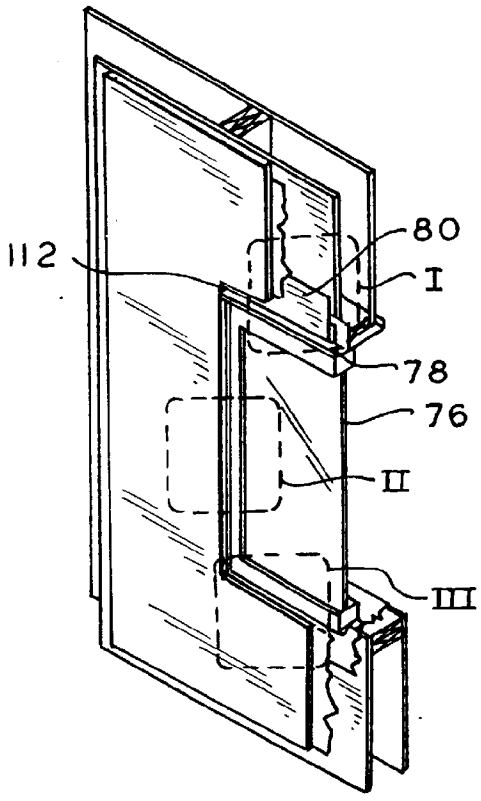


FIG. 9

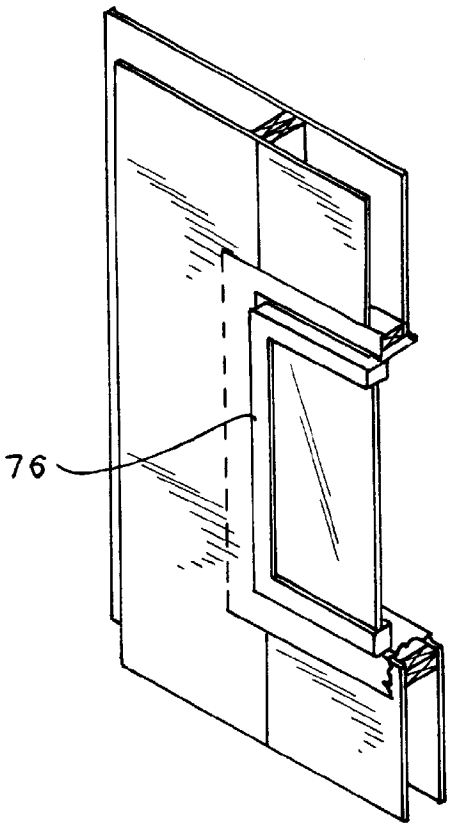
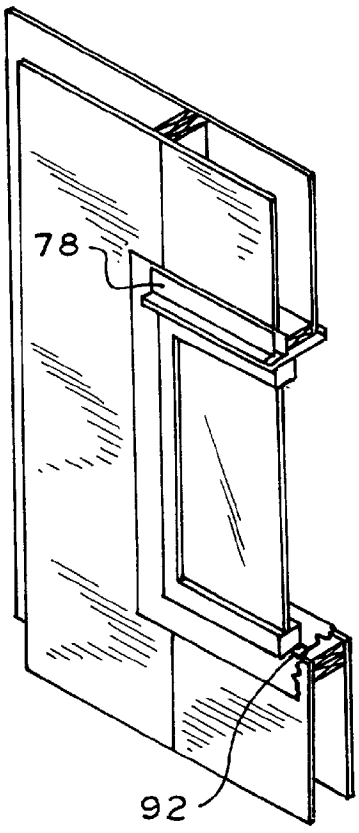


FIG. 10



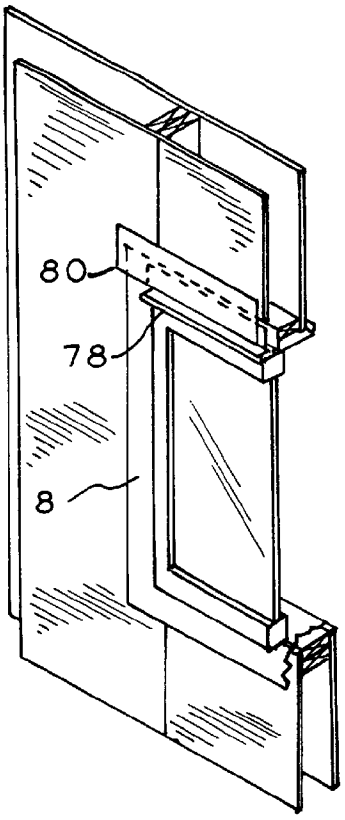


FIG. 11

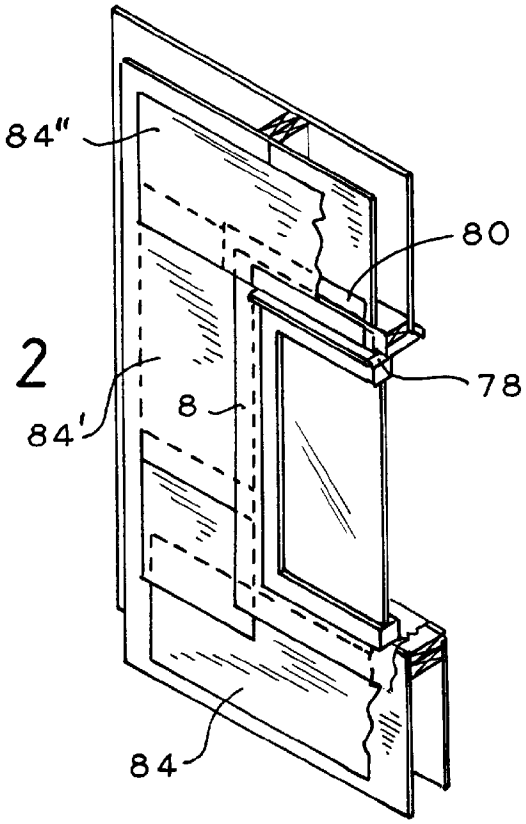


FIG. 12

FIG.14

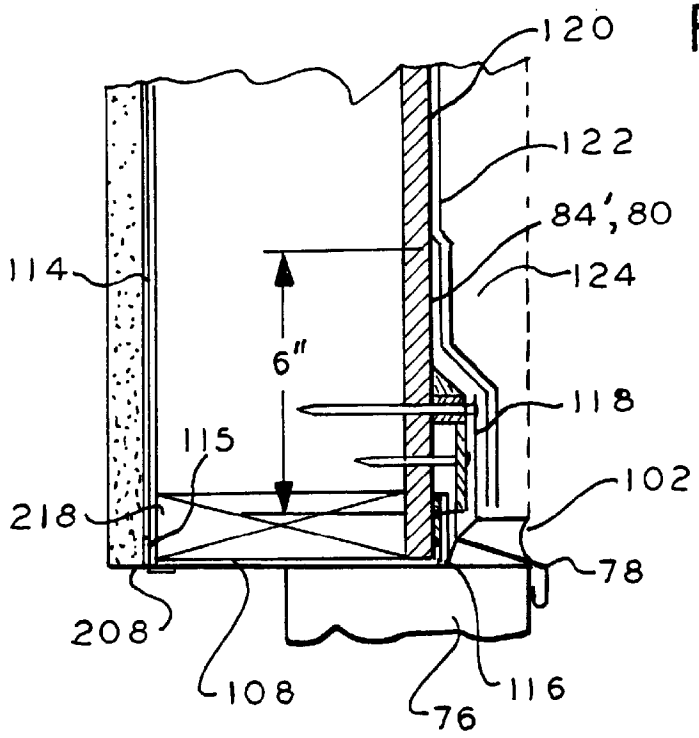

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FIG.15

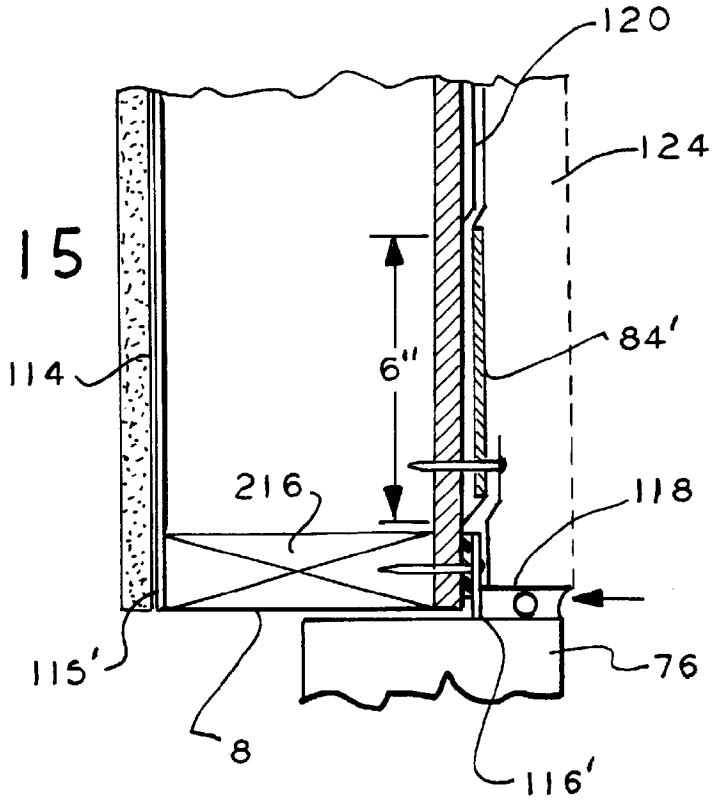
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FIG. 16

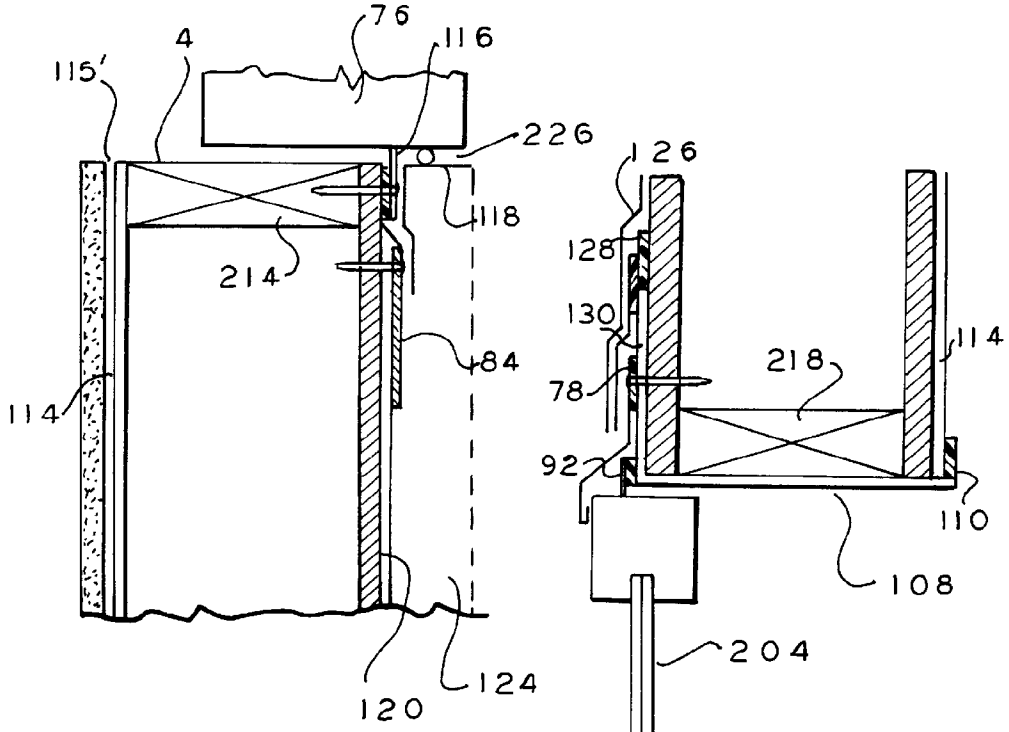
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FIG. 17

FIG. 18

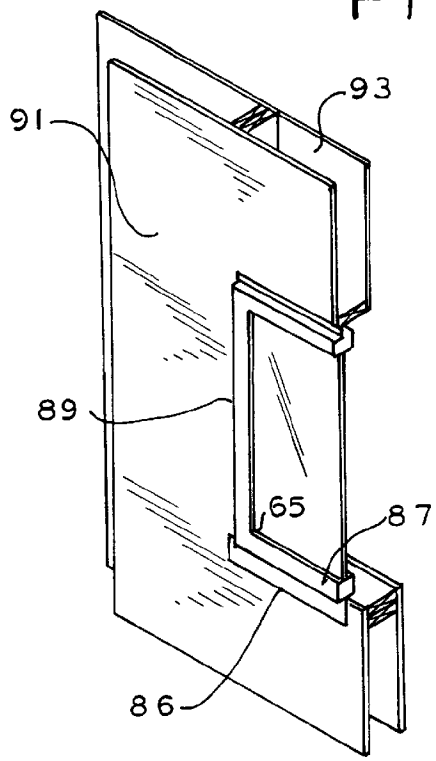


FIG. 19

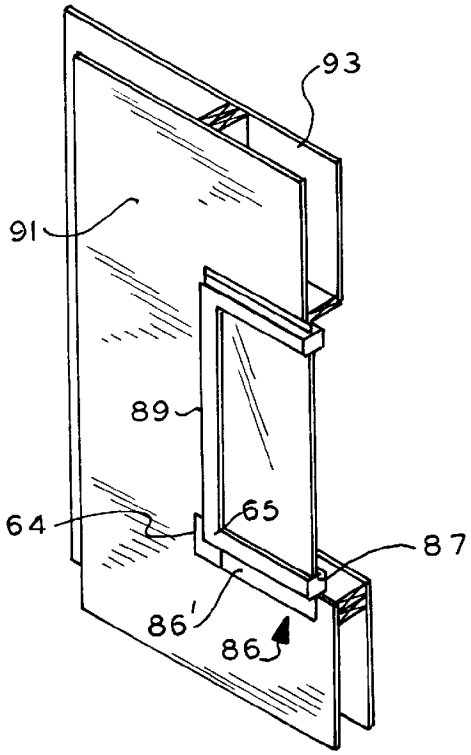


FIG. 19a

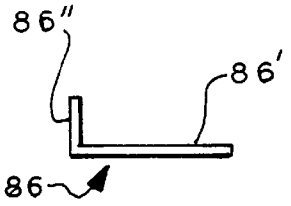


FIG. 20

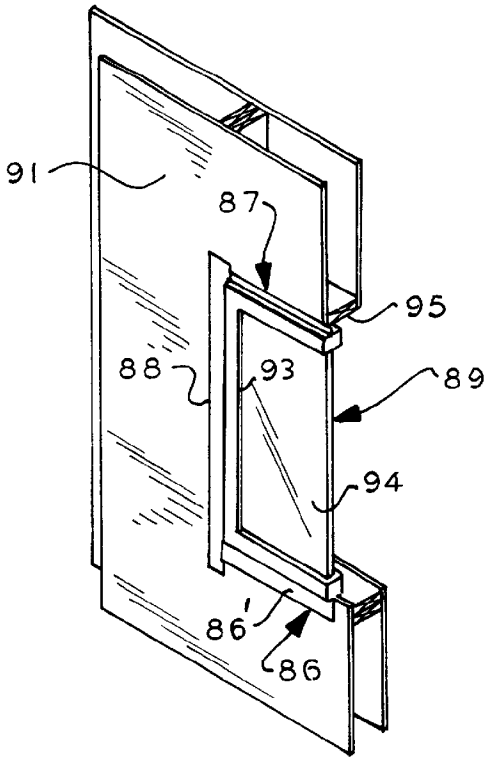


FIG. 21

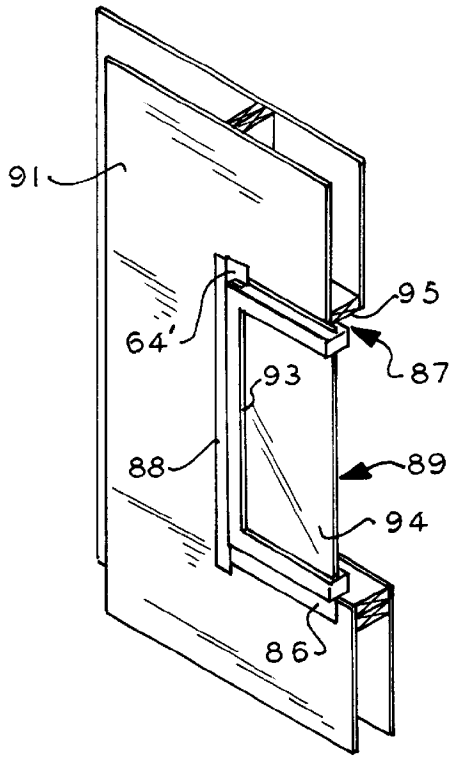


FIG. 22

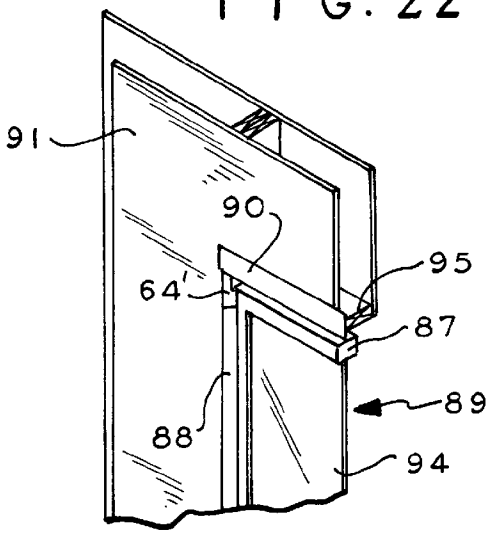
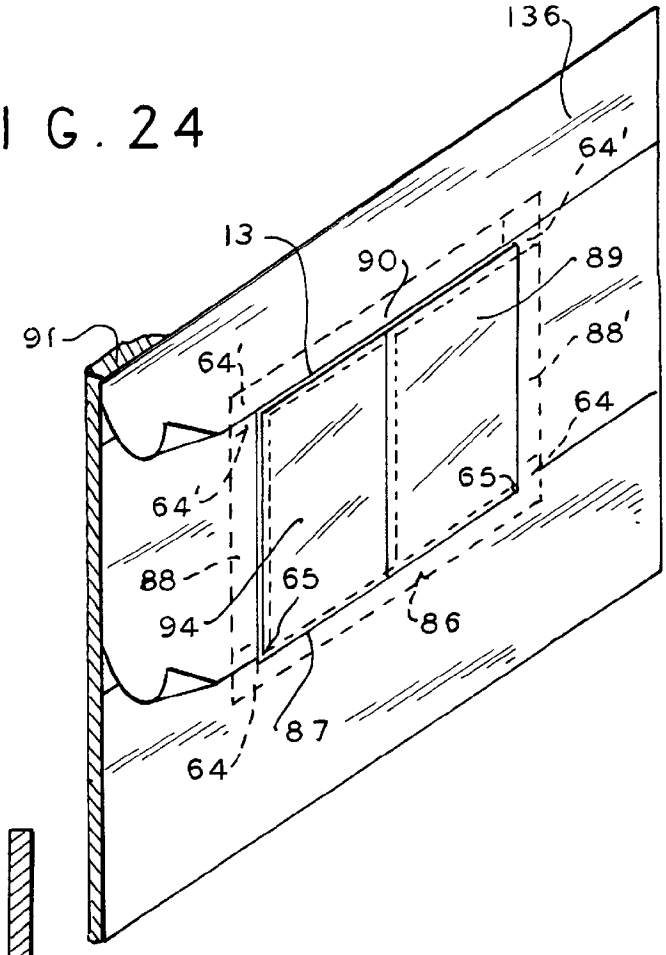


FIG. 24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64'
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87
64

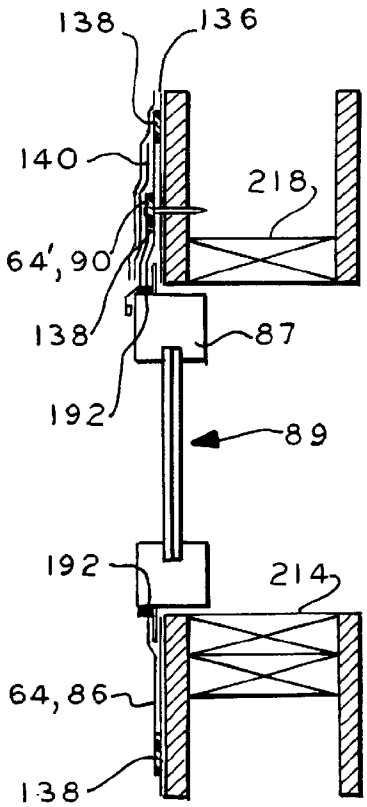

138
136
140
218
64', 90
138
87
192
89
192
214
64, 86
138

FIG. 23

WINDOW SEAL CONSTRUCTION

This application claims the benefit of Provisional Application No. 60/191,364, filed Mar. 22, 2000.

This invention relates to a window or door construction for sealing window or door frames to a wall.

Development of nail-on windows occurred in the 1970's and originally incorporated aluminum frames and then vinyl frames, which comprise the majority of residential windows.

The window assembly must be water tight within the exterior wall and must be flashed. The flashing seals the window into the exterior wall opening to establish resistance to air and water infiltration. The degree of water resistance should match that of the adjoining wall cladding while the material must breath to allow for outward migration of moisture vapor.

Windows are prefabricated assemblies that are installed into typical frame or other construction walls. The problem of installation of such assemblies is to provide seals for resisting water and moisture penetration at the transition between window frame and the wall structure's 'rough opening'. Windows typically are sealed to the frames with flashing materials in combination with adjoining weather resistive barrier (WRB) materials. Asphalt-based flashings and laminated flashings and building papers do not resist constant exposure to water or continuous cycles of wetting and drying commonly associated with the subject portion of the building envelope.

Window assemblies of recent design have integral nailing flanges which are used to nail the assemblies to the wall frame construction. The altered methods of window installation inherent to these 'nail-on windows' require an altered method of flashing the window to the exterior wall weatherproofing.

Nailing flanges provide a method of securing the window to the exterior wall framing. They also provide a flat surface onto which a flashing component and sealant can be applied and compressed to create a waterproof seal. Typically, the nailing flange is used as a transition point for the weather resistive barrier installed at adjoining wall areas.

In FIG. **1**, a typical nail-on window frame assembly **6** is shown. The assembly **6** includes a glass pane **94** set in a frame **96**. Flashing materials **98**, **99** and **100** overlap the nailing flanges on the respective head **102**, jamb **104** sides of the frame **96** and under the sill flange **106**. The flashing materials **98**, **99** and **100** are typically of polyethylene material or the like of low permeance, e.g., about 0.30 perms, exhibiting negligible moisture vapor penetration therethrough. The flashing materials **98**, **99** and **100** are applied sequentially as separate strips resulting in overlap at regions A, B and so on at each of the corners. The flashing materials are applied with an adhesive to the mating wall construction. Such barriers are available as Moistop E-Z Seal from Fortifiber of Los Angeles, Calif. The material has a vapor permeance of less than about 0.3 perms, as determined following ASTM E96 procedures. This material also is not heat weldable. Other flashing materials may utilize modified bitumen membranes such as Blueskin and Vycor, trademarks for materials used for such membranes as known in this industry.

Due to construction sequencing, the window assembly **6** is typically installed before the flashing materials **98**, **99**, and **100**. In many instances, the flashing materials are improperly lapped onto the nailing flange resulting in leakage. As an improvement, strips of weather resistive barrier or special flashing material (not shown) are installed under the nailing flange on three sides (sill and both jambs) at the time of the window installation. This provides a large area of transition and a material assisting in the formation of a compression seal under the window nailing flange. The seal is, in some applications, augmented by the use of a sealant bead between the underside of the nailing flange and top side of the flashing material. Since the window assemblies **6** are installed during the framing and sheathing process, the flashings are exposed to the weather and can be damaged by weather/exposure.

Once a window assembly with an integral window flange is installed, it is difficult to install a workable flashing without the removal of the window from the opening. The removal can damage the interior window trim and the insulation installed in the framing void between the window profile and the wood framing.

In an effort to design assemblies that can be installed to the outside of a window profile, self-adhering membranes such as the Moistop E-Z Seal noted above have been employed to provide a waterproofing seal. These membranes typically have a very low perm rating trapping moisture vapor at the window perimeter. This can result in deterioration of the wood framing and of the window profile if constructed of wood.

Flashing materials have been developed to wrap the wood framing to the building interior to protect the wood framing from leakage and from the effects of moisture vapor entrapment and condensation accumulation. These materials typically are joined by overlaps, and, in some cases, with a tape to seal the overlaps.

The evolution of both methods of application and materials offered to the market has resulted in the lack of a standardized method of installation and a variety of materials, not all of which are compatible with various weather resistive barriers.

All windows do not provide closed assemblies, and water can leak through the frame that is constructed of individual components mechanically secured at the interior corners. Flashing plays an important role in moisture control of such windows.

Windows are fabricated with mullions, both horizontal and vertical, that are mechanically secured to the window profile and which can leak water. Thus a strong durable seal is needed that can form a full weather tight seal over the entire window opening tying the exterior weather resistive barrier to the interior vapor barrier retarder with an effective flashing seal. While overlaps of prior art strip seals shown in FIG. **1** will shed water, they do not keep water from entering due to pressure differentials. Moreover, joints at the sill create pinholes where the strips intersect at changes of plane. These pinholes are sources of water entry both by gravity flow of water as well as due to pressure differentials. Typically such pinholes may be sealed with dabs of sealant which is not a reliable permanent seal.

Most current flashing assemblies require removal of the window for installation. A flashing material that can be applied to the installed window is a self adhering membrane that is bonded to the outer flange of the window and to the exterior sheathing. That sheathing is usually exterior grade gypsum or engineered wood such as plywood or oriented strand board. Self adhering membranes are usually made of modified bitumen. The combination of the modified bitumen and the adhesive creates a very low perm rating at the seal. This can result in the collection of condensation under the flashing transition and can damage the underlying moisture sensitive components.

Prior to the development of nail-on windows, windows were typically flashed with a metal pan under the window or

door. The pan was formed typically of metal or some other rigid material forming a tray. The jamb edges and the back of the sill were turned up to form end dams. The vertical joints were sealed with a sealant or were soldered or welded. The so called tray was especially fabricated to conform to the dimensions of the associated opening. The tray is installed at the ends of the jambs (vertical) or with clips on the rear side. Flashing strips were installed at the jambs running into the tray. Water entering at the head or jambs was directed to the sill tray. The sill tray remained open at the bottom to allow water that enters the assembly to drain out.

Sill trays cannot be used with nail on windows without modification by removing a bottom flange to allow water to exit the assembly. This reduces the strength of the attachment with one plane not attached. Due to potential of compression of wood frame construction, the head of the window is not attached to allow for movement. An alternate method of attachment would be required to modify a nail-on window for use with a sill tray. Sill trays are typically used for flangeless windows that sit in a tray. The nail-on concept is based on sealing the entire window into the opening and creating an air and water barrier on all four sides, yet allowing any water vapor to transfer through the flashing.

There is commercially available a sill tray that is adjustable to fit different size openings.

U.S. Pat. No. 4,555,882 discloses a moisture guard, i.e., a sill tray, for window frames, door jambs and so on. The guard comprises a metallic facing fixed to a rigid plastic molding such as ABS plastic. The sill of a window frame or the sill of a door frame is seated on the metallic facing. The moisture guard has a Z shaped cross section. An integrally formed upstanding rear flange is at the rear edge of the base and an integrally formed depending front flange is at the forward front edge of the base. At an end of the base is formed an end flange with an upstanding vertical wall and with a vertical side wall. The height of the vertical side wall is coextensive with the height of the upstanding end wall and the vertical side wall extends to the depth of the depending front flange. This structure is somewhat as described above in connection with sill trays and has the disadvantages as described therewith. Because the material is of low permeance, it does not allow moisture within the structure to escape. The present inventors recognize that this structure is not as desirable for sealing nail-on window frames and may still be subject to leakage and vapor damage due to interior condensation. It is also not especially adaptable to headers and vertical jambs.

Other flashing and weather stripping arrangements are disclosed in U.S. Pat. Nos. 690,648; 1,411,352; 1,808,336; 2,363,524; 4,126,966; 4,302,262; 4,509,999; 4,700,512; 4,966,819; 5,018,333; 5,086,596 and 5,586,415. None of these are believed to solve the problems discussed herein.

There have been available various methods to form seals and create gaskets at flanges. There has yet to be provided an effective yet flexible system that provides a complete watertight seal out of flexible components that will form to virtually any substrate, eliminate pinholes, provide a durable weatherproofing, easily be sealed to adjoining components, and easily integrated with the wall vapor barrier.

A seal construction according to the present invention is for a nail-on window or door frame, the frame for installation in a window or door opening formed by a horizontal sill, a horizontal head and vertical jambs connecting the sill to the head, the wall at the sill, head and jambs having front and rear faces. The seal construction comprises an integral unitary corner pliable sheet material sealing member that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial moisture vapor entrapment and condensation collection in the interior of said wall at the window opening while providing a water barrier to liquid water applied thereto. The seal member comprises a first portion for overlying a selected portion of one of the front face at the head and sill, a second portion normal to the first portion and sealingly connected to the first portion for overlying a portion of the jamb at the selected one of the head and sill and a third portion sealingly connected to and normal to the first and second portions for overlying the front face adjacent to the selected one of the head and sill portions and adjacent to the jamb portion.

In one aspect, at least a portion of a first surface of the seal member includes embedded reinforcing fibers for enhancing sealant adherence to the first surface.

In a further aspect, the seal member comprises polyelthylene.

In a further aspect, the first and second portions are each planar connected by a right angle joint therebetween, the third portion comprising an L-shaped member having a first leg depending from the first portion at a right angle thereto and a second leg extending at a right angle to the first leg and extending from the second portion at a right angle thereto.

In a further aspect, a fourth rear portion overlies a portion of the rear face of the selected one of the sill and head, the fourth portion depending from the first portion and juxtaposed with the first leg, and a fifth rear portion extending from the second portion juxtaposed with the second leg for overlying a portion of the rear face of the jamb.

Preferably the first and second portions and a portion of the first and second legs are formed of one piece sheet material, further including a triangular interface section between and bonded to at least a portion of the first and second legs.

In a further aspect, the first and second portions comprise integral one piece sheet material, the first and second portions each having a flange depending therefrom for overlying the rear face and comprising an L-shaped planar sheet member.

In a still further aspect, a method of making a seal construction for a window or door opening in a wall for receiving a nail-on frame for insertion into the opening formed which is formed by a horizontal sill, a horizontal head and vertical jambs connecting the sill to the head, the wall at the sill, head and jambs having front and rear faces. The method comprises forming a flat pliable water impervious first sheet having a permeance sufficient to permit water vapor to permeate therethrough to preclude moisture vapor entrapment and condensation from substantially accumulating on a side thereof at a first edge. A slit is formed in the sheet and has opposing edges. The opposing edges of the slit are spread apart and sealingly attached to a second sheet made of the same material as the first sheet to form a one piece sheet member having a sill or head portion for overlying a sill or head of the opening, a jamb portion for overlying a portion of the jamb normal to the sill or head portion and a front face portion for overlying the front face of the wall at the sill or head and adjacent to the jamb.

The method further comprises forming a rear flange portion extending from a second edge of the sheet material opposite the first edge for overlying a portion of the rear face at the sill or head and jamb.

In a further aspect, the sheet material has a first fold line extending thereacross to opposing second and third edges of

the sheet material and a second fold line extending from a fourth edge of the sheet material medially the second and third edges normal to the first fold line and terminating at the first fold line, the slit extending from the junction of the first and second fold lines to the first edge.

In a further aspect, a method of making a seal for a nail-on a window or door opening in a wall, the opening being formed by a horizontal sill, a horizontal head and vertical jambs connecting the sill to the head in the wall, the wall at the sill, head and jambs having front and rear faces, comprises forming a corner seal from a flat sheet of a liquid water repellant pliable material having a permeance sufficient to permit water vapor to pass therethrough in response to a pressure differential across opposing sides of the material to preclude moisture vapor entrapment and condensation on a first side thereof while repelling liquid water incident thereon on a second side, the corner seal comprising a flat first portion for overlying the sill or head and a flat second portion for overlying the jamb, the second portion being integral and one piece with the first portion and forming a flat front face member sealingly attached to the first and second portions for overlying a portion of the front face of the wall at the sill or head and jamb.

In a still further aspect, a method of sealing a window or a door opening in a wall, the opening being formed by a horizontal sill, a horizontal head and vertical jambs connecting the sill and head in the wall, the wall at the sill, head and jambs having front and rear faces, comprises forming a corner seal member of pliable sheet material that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross, the seal member comprising a first portion for overlying a selected portion of one of the sill or head, a second portion normal to the first portion and sealingly connected to the first portion for overlying a portion of the jamb at the selected one of the head and sill and a third front face portion sealingly connected to and normal to the first and second portions for overlying the face of the wall adjacent to the selected one of the head and sill portions and adjacent to the jamb portion. Then attaching the seal member to each of two lower interior corners of the opening at the juncture of the sill and jambs at each end of the sill. Then sill, head and jamb seal members are formed each comprising an elongated L-shape in section member formed of the pliable sheet material and including a first portion for overlying a selected sill, head and jamb and a second portion for overlying the front face; attaching the sill member over the first portions of the corner seal member at each lower corner of the opening and over the sill and over the front face at the sill; and attaching the jamb seal to each vertical jamb over the second jamb portions of each attached corner seal member at the lower corners and over the front face. Then a corner seal member second portion is attached over the jamb seal members at each upper corner of the opening and the first portion over a portion of the head. Finally a head seal member is attached over the first portions of the corner seal members at the head-jamb corners of the frame, and over the head and face.

A retrofit seal construction according to a further aspect of the present invention is for sealing an installed window or door frame in a wall having a front face and a rear face, the frame for enclosing a window or door opening formed by a horizontal sill, a horizontal head and vertical jambs connecting the sill to the head in the wall. The seal construction comprises an integral unitary corner member seal formed of pliable sheet material exhibiting a breathable perm value that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of said wall at the opening while providing a water barrier to liquid water applied thereto. The corner member seal comprises an L-shaped planar element of the material with a first leg and a second leg normal to the first leg for overlying the front face adjacent to the sill or head and jamb. A first flange extends outwardly from the first leg for overlying and sealingly attachment to the frame at the sill or head and a second flange extends outwardly from the second leg at a right angle to the first flange for overlying and sealing attachment to the frame at the jamb, the first and second flanges being sealing joined to each other and to the legs at the juncture therebetween and the legs.

A method of sealing a window or door opening in a wall according to a further aspect of the present invention comprises applying pliable sheet material exhibiting a breathable perm value greater than 0.4 that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of the wall at the opening while providing a water barrier to liquid water applied thereto to the sill, jambs and head interior surfaces of the window or door opening and to the exterior sheathing at the sill, jambs and head in a bonded plurality of strips of the material.

IN THE DRAWING

FIG. **1** is an isometric fragmented sectional view of an installed window frame structure with prior art flashing materials;

FIG. **2** is an exploded view of a window installation according to an aspect of the present invention;

FIG. **3** is an isometric view of a corner barrier membrane seal according to an aspect of the present invention;

FIGS. **3***a*, **3***b* and **3***c* are various stages of forming the corner membrane seal of FIG. **3**;

FIG. **4** is an exploded view of the construction of a further embodiment of a corner barrier membrane seal;

FIG. **5** is an isometric view of a further embodiment of a corner membrane seal for retrofit applications;

FIGS. **6–13** are fragmented sectional isometric views of a window installation at various stages of installation of a window in a new construction with various barriers seals and methodology according to further aspects of the present invention;

FIG. **14** is a cross section elevation view of a window head flashing arrangement taken at region I, FIG. **13**;

FIG. **15** is a cross section elevation view of a window jamb flashing taken at region II, FIG. **13**;

FIG. **16** is a cross section elevation view of a window sill flashing arrangement taken at region III, FIG. **13**;

FIG. **17** is a sectional elevation view of a window in new construction according to an aspect of the present invention;

FIGS. **18–22** are fragmented sectional isometric views of a window installation at various stages of installation of a window with a retrofit seal arrangement, various barriers seals and methodology according to further aspects of the present invention; and

FIG. **23** illustrates an elevation sectional view of the retrofit embodiment of FIGS. **18–22**.

FIG. **24** illustrates an isometric view of the retrofit embodiment with various barriers seals and methodology.

In FIG. **2**, a conventional nail-on window **200** comprises a frame **202** and a transparent pane **204**. The window **200** is to be installed in opening **206** in wall **208**. The wall **208** has a front face **210** and a rear face **212**. The wall **208** opening **206** has a horizontal sill **214**, a vertical jamb **216** on each side of the opening, and a horizontal head **218**.

Initially two corner seals **2** according to the present invention are attached to the wall **208** over portions of the sill **214**, a portion of each of the jambs **216** and a portion of the front face of the wall **208** at each of the lower corners **220**.

The corner seal **2** is shown in FIG. **3**. The seal **2** comprises a permeable flexible plastic membrane sheet material, e.g., polyethylene, polyvinylchloride (PVC) or thermoplastic polyolefin, for use in new constructions. The sheet material exhibits a high perm rating (e.g., greater than 0.400, preferably about 0.42 and more preferably about 0.468) to release water vapor that may build up at the window perimeter in the interior portions thereof. The water vapor permeates through the material due to pressure differentials across the material rather than collect in interior regions of the wall **208** as condensation. The material of the seal provides a positive moisture seal at the corner of the window frame and overlaps in the adjacent wall regions. The seal **2** incorporates a thermoplastic membrane and woven or non-woven fibrous fleece mesh impregnated on one or both sides of the sheet material to create a rough fibrous surface, such as surfaces **3**, **5**, **7** and **9**, that will provide a tenacious bond to the weather resistive barrier with either a factory of field applied self adhering strip, double sided tape, spray applied adhesive, sealant (skinning or non-skinning), heat weld, chemical bond, or mechanical fasteners. The seal **2**, FIG. **2**, can bond to either the window frame **202** at the exterior flange thereof or wrap into the window opening **206** to bond to the wall at the sill, head and jamb and interior vapor retarder (not shown in these views) with factory of field applied self adhering strip, double sided tape, spray applied adhesive, sealant (skinning or non-skinning), heat weld, chemical bond, or mechanical fasteners. The seal **2** comprises a prefabricated interior and exterior corner element that can be used to seal the window opening sill, head and jambs to a weather resistive barrier.

The sheet material has a thickness in the range of about 0.020 to about 0.100 inches and preferably about 0.020 to 0.060 inches. The material can be exposed to ambient weather conditions for 6 months without degradation to material performance and is available commercially in a range of widths from 6 inches to 6 feet. The material has the feel and look of a sheet of pliable black rubber. The fibers of the reinforcement are preferably polyester and, in the alternative, may be other fiber materials and provide roughness to a surface of the sheet material.

The prefabricated corner seal **2** includes a face flange **10**, FIG. **3**, which overlies the front face of the wall **208**, a sill or head portion **16** which overlies the sill **214** or head **218** and a jamb portion **18** which overlies a portion of a jamb **216**. The seal has fibrous surface **7** that faces away from the wall **208**. A self adhering L-shaped optional tape or flange **20** extends from the sill portion **16** at the sill portion rear edge and a flange **21** extends from the jamb portion **18** rear edge. The flanges **20** and **21** are preferably integral and one piece with the respective sill and jamb portions of the corner seal **2**. In the alternative, they may be heat sealed or welded. The face flange **10** preferably includes a triangular section **22**. Section **22** is bonded by heat welding or with an adhesive to the adjacent edge regions of the seal **2**. The rough fibrous surface of the section **22** is exterior of the seal **2** and formed by the embedded polyester fibers arrayed in random fashion. In the alternative, the fibrous surfaces may be on the reverse of the surfaces described.

In FIG. **3***a*, the corner seal **2** is fabricated by forming a preferably square sheet of the membrane sheet **26**. A 45 degree slit **28** is formed in the membrane sheet **26** and terminates at edge **29**. Two fold lines **30** and **32** are represented by dashed lines forming sections **31**, **33**, **34** and **38**. Fold line **30** extends normal to edge **25** of the sheet to the slit **28** interior end. The fold line **32** is normal to the fold line **30** and extends from edge **27** to edge **35**. The fold line **32** has two sections, fold line **32'** and foldline **32"**.

In FIG. **3***b*, the fold section **34** formed by the slit **28** and fold line **32"** is folded at fold line **32"** to form an exterior corner **36**. The section **38** formed by slit **28** and fold line **32'** is folded at fold line **32'** to from an exterior corner **40**, FIG. **3***c*. A triangular section **40** of the same material is welded or otherwise bonded permanently to the sheet material at the spread apart slit **28** edges **42** and **44**.

The edges **42** and **44** form a triangular opening in which section **40** is placed and secured in place. The fibrous surface of the section **40** is preferably on the same side of the sheet material as the fibrous surface of membrane sheet **26**.

In the alternative, in FIG. **4**, a corner seal **46** is formed by an L-shaped sheet membrane **48** of the same material forming the seal **2**. A second member **50** has two orthogonal legs **52** and **54**. Flange members **56**, **56'** depend from the outer respective edges **55**, **55'** of the member **50**. Similar flange members **60** and **62** depend from the opposite edges of the respective legs **52** and **54**. Flange members **60** and **62** may also be formed on the seal **2**, FIG. **3**. The seals **2** and **46** are used for new construction.

In a further embodiment, in FIG. **5**, a corner seal **64** for retrofit applications of preinstalled windows or doors comprises membrane sheet material that is the same as the material forming seals **2** and **46**. The seal **64** has normal coplanar legs **66** and **68** forming an L shape. Flange **70** extends normal to leg **66** from an edge of the leg **66** and flange **71** extends normal to leg **68** from an edge of the leg **68**. The flanges **70** and **71** are joined together to form a seal at junction **74**.

The corner seals are fitted with a self adhering strip and with a release strip to secure the corner seals to the underlying substrate and to secure the sill, jamb and head membrane seals to the corner seals.

Elongated L-shaped (in transverse cross section) longitudinal seal sill/head member **4** and jamb member **8**, FIGS. **2**, **6** and **7**, are formed of the same sheet material as seal **2**. The member **4** can be used for both the sill and head and has a sill/head portion **4'** and a front face portion **4"**. The portion **4'** covers the sill **214** or the head **218** inside the opening **206** and sill portions **16** of the corner seals **2** (FIG. **3**). The portion **4"** overlies a portion of the wall **208** front face **210** and a portion of the face flange **10** of the seals **2** adjacent to the sill portion **16** at each lower corner as shown in FIGS. **2** and **6**. The member **4** extends for the width between the jambs **216** (FIG. **2**) of the rough opening **206** in the respective sill **214** or the head **218**.

The member **8** is the same transverse cross section as the member **4** and is used to cover the jambs **216**, **216'** on opposite sides of the opening **206**, FIG. **2**. The member **8**, FIG. **7**, has a jamb portion **8'** that covers a jamb and a front face portion **8"** that overlies a portion of the front face **210**. The member **8** jamb portion **8'** can be cut to form a flange to be adhered onto the exterior front face surface only. The members **4** and **8** are overlaid on the preassembled corner seal **2** at the sill-jamb intersections on opposite sides of the sill **214**.

This process is repeated with the head portion of the window opening in FIG. **8**. In FIGS. **2** and **8**, head corner seal **2'** is attached to the wall **208** at the juncture of head **218** and jamb **216**. In FIG. **2**, corner seal **2"** is attached to the wall **208** at the juncture of head **218** and jamb **216'** opposite jamb **216**. The corners and other seals are attached with the rough surfaces facing the wall **208**. In FIG. **8**, the elongated head seal **108** is then attached to the head **218**. In FIG. **8**, the head seal **108** has an additional rear flange **110** which is optional. A similar flange may be formed on all of the corner seals **2**, **2'** and **2"** and on the sill and jamb seals **4** and **108** interconnected to the corner seals **2**, **2'** and **2"**. All of the corner seals **2**, **2'** and **2"** are preferably identical. In FIG. **2**, a second jamb seal **8** is attached to the jamb **216'**. The seal **8** is L-shaped as is the sill and head seals, with an optional flange such as flange **110**, FIG. **8**. It should be understood that the opposite jamb **8** seals of the window frame are assembled at the same time prior to assembly of the top seals **2'** and **2"**. In all cases, the seals are secured by field or factory applied self adhering strips, double sided tape, spray applied adhesive, a sealant (skinning or non-skinning), heat weld or mechanical fasteners according to a given implementation. The wall **208** is formed on its exterior side with a sheathing substrate.

The nail flange window **76** FIG. **9** is then assembled to the now membrane installed window open frame. In FIG. **10**, the prefinished metal head flashing **78** is then installed in a bed of non-skinning butyl sealant. A 2 inch sealant end dam **112** is applied under the head flashing to either end, FIG. **13**. The flashing **78** is secured with screws but not through the nailing flange **92**, FIG. **10**. The flashing extends for the full width of the window.

In FIG. **11**, a 6" wide membrane, polyethylene composition material weather resistant barrier (WRB) head flashing strip **80** of the same or different material as the corner, sill and head seals is installed over the metal head flashing **78**. A strip of sheet material weather resistant barrier **84** (WRB) is secured and lapped under or over the sill and jamb membrane flashings at the sill and jamb with factory of field applied self adhering strip, double sided tape, spray applied adhesive, sealant (skinning or non-skinning), heat weld, chemical bond, or mechanical fasteners. In FIG. **12**, WRB **84"** is lapped over the metal head flashing at the jambs and over WRB **84'** which is over WRB **84**. The same sealant may be used throughout. Further finishing is applied as shown in FIG. **13**.

In FIG. **14**, a conventional vapor retarder **114** is attached to the interior side of wall **208**. The head seal **108** is attached to the retarder **114** by a flange such as interior flange **115** where possible or else adhered to the wall **208** frame with factory of field applied self adhering strip, double sided tape, spray applied adhesive, sealant (skinning or non-skinning), heat weld, chemical bond, or mechanical fasteners. The window has a head vinyl nail flange **116** which is set in a continous bead of neutral cure silicone. Head flashing **78** is placed over the latter structure which has been previously sealed with the head seal **108**. A weep screed **118**, a J-shaped metal member for retaining stucco (as applicable) **124** is placed over the flashing **78**. A WRB layer **80** is placed over the flashing **78** (FIG. **2**). The six inch membrane flashing **84"** is placed over these elements and secured with silicone. Two layers **120** of 60 min. grade D weather resistive barrier sheet material is placed over the above structures. A metal lathe **122** is then placed over the above materials. FIGS. **15–16** show the sectional views of the installation at regions II and III of FIG. **13** wherein like numbers represent like materials in the other figures. In FIG. **15** the seal **8** is shown with an interior flange **115'**, preferably about one inch wide, as in all of the flanges of the various sill, head and jamb seals, which is bonded to the vapor retarder **114**. This interior flange may be nothing more than an extension of the sill, jamb and head portions of the seal which is bent at the vapor retarder in order to bond it to the retarder where possible. A one half inch sealant joint **226** has a closed cell backer rod.

The material forming the corner, sill, head and jamb seals can be heat welded which is not true of the Moistop seal of the prior art. The prior art materials used as seals known at Moistop can not be heat welded and has a relatively low perm of 0.3, which is not desirable as this provides negligible vapor penetration through the material with respect to the 0.468 perm of the material used in the seals of the present invention.

In FIG. **17**, window nail frame **92** is set in a sealant bead. A metal head flashing **78** is set in sealant. A WRB **126** is over the metal flashing **78**. A reinforcing mesh **128** is adhered to the substrate. A membrane head flashing **130** is adhered to the metal flashing **78** and membrane head seal **108**. The seal **108** has a flange **110** adhered to the vapor retarder **114**. The seal **4** has a flange **132** sealed to the retarder **114**. FIG. **2** shows the sequence in exploded form for the corner seal **2** installation.

In FIGS. **18–23** a retrofit seal installation is shown of a flashing system where the window assembly is already in place and cannot be removed without damaging the interior window trim and insulation installed in the framing void between the window profile and the wood framing. In FIG. **18**, in a retro fit application to a preinstalled window, a sill strip seal **86** of the same material as discussed above in respect of corner seal **2**, is installed beneath the sill frame **87** of the window **89**. The sill seal **86**, FIG. **19***a*, is L-shaped and has a leg portion **86'** bonded to the sheathing **91** on the exterior of wall **93** and a leg portion **86"** that is at right angles to the sheathing bonded to the under side of the window **89** sill frame **87**.

A corner seal **64** (FIG. **5**), of the same material as seal **2**, is installed at the window **89**, having a pane **94**, outer lower corners **65**, FIG. **24**, over the sill frame portion that is normal to the sheathing **91** and over the jamb portion normal to the sill portion. The seal **64** also has a portion that is bonded over the sheathing **91**. For example, flange **70** of seal **64**, FIG. **5**, is bonded to the lower surface of the sill frame **87**. The leg **66**; is bonded over the sill seal **86**. The flange **71** is bonded to the jamb frame **87**. The leg **68** is bonded to the sheathing **91**.

Jamb strip seals **88**, **88'**, comprising membrane material of the same construction as seal **2** and seal **86**, are then installed over the corner seals **64**. The seal **88**, at a leg thereof corresponding to leg **86'** of seal **86**, FIG. **19***a*, is bonded and sealed to the sheathing **91** and to corner seal **64**. A second leg of seal **88** corresponding to leg **86"**, FIG. **19***a*, is bonded to the window frame **87** at the jamb **93** and also overlies the corner seal **64** on the jamb portion. The membrane seals **86** and **88** are adhered to the window frame **89** and not to the nailing flange.

In FIGS. **21** and **24**, upper corner seals **64'** are bonded and sealed to the sheathing and to the frame **89** at head **95** and over the jamb seals **88** and **88'** in a manner similar to the lower corner seals **64**. In FIG. **22**, head seal **90**, which is L-shaped as seal **86**, FIG. **19***a*, is attached to the sheathing at head **95** and to the window **89** frame **87** at the head and overlies upper corner seal **64'**.

FIG. **23** shows the sectional view of the installed seals and flashings in the retrofit embodiment. In FIG. **23**, the window has an existing WRB **133**. A reinforcing fabric **138** is sealed

to existing substrate or WRB **133**. A new weather resistive barrier **136** is placed over the fabric **138** and over the prefabricated corner and strip flashing formed by corners **64'** and strip head seal **90**.

Thus a thermoplastic flashing system is described that incorporates a strip sheet material membrane with a woven or non-woven polyester or polypropylene reinforcement encapsulated into the thermoplastic sheet material of the membrane. This provides both reinforcement for the thermoplastic sheet material and a mechanical bonding surface for bonding to the weather resistive barrier or underlying substrate. An optional factory or shop applied self adhering seal strip may be applied to any surface to ease installation in the field. Preformed corners are placed at all four corners of a wall penetration to provide a watertight seal at vertical to horizontal transitions. The prefabricated corners may be fitted with a self-adhering seal strip with a release backing to secure the corners to the underlying substrate and to secure the membrane strips to the corner pieces. Alternatively, the corners and strips may be secured and joined with field applied sealant.

In addition to the use of self-adhering strips or sealant, the thermoplastic strip can be heat welded, solvent welded or adhered with a sealant to form the desired seals. The corners are formed from two pieces with either a single or a double weld to bond the sections together (FIGS. **3**, **3***a*, **3***b* and **3***c*). The corner provides water proofing protection at the corner where the membrane changes plane. The corner piece can extend into the window opening to the interior vapor retarder. The sheet material forming the 90° angle can be cut to form the flange **20** (FIG. **3**) to bond to an interior vapor retarder. The corners are connected with a membrane strip (sections **4** and **8**, FIG. **7**) of the same material as the corners. The components are installed in such a manner that all joints shed water.

In FIGS. **2** and **17** system, a compression seal is formed at the window flange with a preinstalled sealing tape at the transition. In the alternative, a two-sided foam, sealant or butyl tape (not shown FIG. **17**) is field applied to form a compression seal under the nailing flange **92**.

The sheet material used as a sealant membrane in the disclosed embodiments herein is commercially available. This material has been used as a tank liner, roofing liner and pool liner, among other uses. This material, however, has never been used as a window or door flashing in the manner disclosed herein.

It will recur to one of ordinary skill that various modifications may be made to the disclosed embodiments without departing from the scope of the invention as defined on the claims appended hereto.

What is claimed is:

1. A seal construction for a nail-on window or door frame, the frame for installation in a window or door opening in a wall, the opening being formed by a horizontal sill, a horizontal head and vertical jambs connecting the sill to the head, the wall at the sill, head and jambs having front and rear faces, the seal construction comprising:

an integral unitary corner pliable sheet material seal member exhibiting a breathable perm value that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of said opening while providing a water barrier to liquid water applied thereto;

the seal member comprising a first portion for overlying a selected portion of one of the head and sill, a second jamb portion normal to the first portion and sealingly connected to the first portion for overlying a portion of the jamb at said selected one of the head and sill and a third front face portion sealingly connected to and normal to the first and second portions for overlying the front face of the wall adjacent to the selected one of the head and sill portions and adjacent to the jamb portion.

2. The seal construction of claim **1** wherein at least a portion of a first surface of the seal member includes embedded reinforcing fibers for enhancing sealant adherence to the first surface.

3. The seal construction of claim **1** wherein the first and second portions are each planar connected by a right angle joint therebetween, the third portion comprising an L-shaped member having a first leg depending from the first portion at a right angle thereto and a second leg extending at a right angle to the first leg and extending from the second portion at a right angle thereto.

4. The seal construction of claim **1** further including a fourth rear portion for overlying a portion of the rear face at the selected one of the sill and head, the fourth portion depending from the first portion and juxtaposed with the first leg, and a fifth rear portion extending from the second portion juxtaposed with the second leg for overlying a portion of the rear face at the jamb.

5. The seal construction of claim **4** wherein the first and second portions and a portion of the first and second legs are formed of one piece sheet material, further including a triangular interface section between and bonded to at least a portion of the first and second legs.

6. The seal construction of claim **4** wherein the first and second portions comprise integral one piece sheet material, the first and second portions each having a flange depending therefrom for overlying the rear face, and comprising an L-shaped planar sheet member.

7. A method of making a seal construction for a window or door opening in a wall for receiving a nail-on frame, the frame for insertion into the opening formed by a horizontal sill, a horizontal head and vertical jambs connecting the sill to the head, the wall at the sill, head and jambs having front and rear faces, the method comprising:

forming a flat pliable liquid water impervious first sheet having a perm sufficient to permit water vapor to permeate therethrough to preclude condensation from substantially accumulating on a side thereof;

forming a slit with opposing edges in the sheet in communication with a first sheet edge; and

spreading the opposing edges apart and sealingly attaching a second sheet made of the same material as the first sheet to the opposing edges of the slit to form a one piece sheet member having a sill or head portion for overlying a sill or head of the opening, a jamb portion for overlying a portion of the opening jamb normal to the sill or head portion and a front face portion for overlying the front face of the wall at the sill or head and adjacent jamb.

8. The method of claim **7** further comprising forming a rear flange portion extending from a second edge of the sheet material opposite the first edge for overlying a portion the rear faces of the seal or head and jamb.

9. The method of claim **8** wherein the sheet material has a first fold line extending thereacross to opposing second and third sheet material edges and a second fold line extending from a fourth edge of the sheet material medially the second and third edges normal to the first fold line and terminating at the first fold line, the slit extending from the junction of the first and second fold lines to the first edge.

10. A method of making a seal construction for a nail-on a window or door opening in a wall, the opening being formed by a horizontal sill, a horizontal head and vertical jambs connecting the sill and head, the wall at the sill, head and jambs having front and rear faces, the method comprising:

forming a corner seal from a flat sheet of a liquid water repellant pliable material having a perm sufficient to permit water vapor to pass therethrough in response to a pressure differential across opposing sides of the material to preclude condensation on a first side thereof while repelling liquid water incident thereon on a second side, the corner seal comprising a flat first portion for overlying the sill or head and a flat second portion for overlying the jamb, the second portion being integral and one piece with the first portion; and

forming a flat front face member sealingly attached to the first and second portions for overlying a portion of the front face of the wall at the sill or head and jamb.

11. The method of claim 10 wherein the method of forming the sheet includes forming the sheet of fiber reinforced polyethylene having a smooth first surface and a fibrous second surface.

12. The method of claim 11 including attaching the corner seal to the sill or head and jamb with a sealant at the fibrous surface.

13. A method of sealing a window or a door opening in a wall, the opening being formed by a horizontal sill, a horizontal head and vertical jambs connected to the sill and to the head, the wall at the sill, head and jambs having front and rear faces, the method comprising:

forming a corner seal member of pliable sheet material that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross, the seal member comprising a first portion for overlying a selected portion of one of the head and sill, a second jamb portion normal to the first portion and sealingly connected to the first portion for overlying a portion of the jamb at said selected one of the head and sill and a third front face portion sealingly connected to and normal to the first and second portions for overlying the face of the wall adjacent to the selected one of the head and sill portions and adjacent to the jamb portion;

attaching the seal member to each of two lower interior corners of the window or door opening at the juncture of the sill and jambs at each end of the sill;

forming sill, head and jamb seal members each comprising an elongated L-shape in section member formed of said pliable sheet material and including a first leg portion and a second leg portion;

attaching the sill seal member first leg portion over the first portions of the corner seal member at each lower corner of the window or door opening and the second leg portions thereof over the front face;

attaching said jamb seal member first leg portion over each vertical jamb and over the second jamb portions of each said attached corner seal member at said lower corners and the second leg portions thereof over the front face;

then attaching a corner seal member second portion over the jamb seal members at each upper corner of the opening and the first portion over a portion of the head; and then

attaching a head seal member first leg over the first portions of the corner seal members at the head-jamb corners of the frame and over the head and the second leg portions over the front face at the head.

14. A method of retrofit sealing an installed window or door and frame, the frame for enclosing an opening in a wall formed by a horizontal sill, a horizontal head and vertical jambs connected to the sill and to the head, the wall at the sill, head and jambs having front and rear faces, the method comprising:

sealingly attaching a first flat strip of sheet pliable sheet material on the exterior surface of the wall front face adjacent to the sill, the sheet material repelling liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross;

forming a plurality of corner members each comprising said sheet material, the corner members comprising an L-shaped planar element with a first leg and a second leg normal to the first leg, a first flange extending outwardly from the first leg and a second flange extending outwardly from the second leg, the first and second flanges being sealing joined to each other and to the legs at the juncture therebetween and the legs;

sealingly attaching the legs of a first corner member to the front face at the juncture of the sill and a first jamb to the front face at the juncture of the sill, sealingly attaching the first flange of the first corner member to the frame adjacent to the sill and the second flange to the frame adjacent to the first jamb and sealingly attaching a second corner member to the front face at the juncture of the sill and a second jamb and to the frame in the same manner as the first corner member;

sealingly attaching a second flat strip of said sheet material on the front face adjacent to the first and second jambs over a leg of the corner members at each corner at the junction of the sill and jambs;

sealingly attaching a third corner member to the front face over the second flat strip with the first leg adjacent the first jamb and the second leg adjacent to the head and repeating this step with a fourth corner at the second jamb and head; and

sealingly attaching a further flat strip to the exterior surface adjacent to the head over a leg of each of the third and fourth corners and a flange attached to the further flat strip to the frame at the head.

15. A retrofit seal construction for an installed window or door frame in a wall having front and rear faces, the frame for enclosing an opening in the wall formed by a horizontal sill, a horizontal head and vertical jambs connecting the sill to the head, the seal construction comprising:

an integral unitary corner member seal formed of pliable sheet material exhibiting a breathable perm value that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of said wall at the opening while providing a water barrier to liquid water applied thereto;

the corner member seal comprising an L-shaped planar element of said material with a first leg and a second leg normal to the first leg for overlying the front face of the wall adjacent to the frame and a first flange extending outwardly from the first leg for overlying and attachment to the frame adjacent to the sill or head and a second flange extending outwardly from the second leg at a right angle to the first flange for overlying and attachment to the frame adjacent to a jamb, the first and

second flanges being sealing joined to each other and to the legs at the juncture therebetween and the legs.

16. The seal construction of claim **15** wherein the corner member is one piece sheet material.

17. The seal construction of claim **15** wherein the sheet material comprises polyethylene reinforced with fibers to form a smooth surface on one side and a rough fibrous second side adapted to adheringly receive an adhesive.

18. A method of sealing a window or door opening comprising applying pliable sheet material exhibiting a breathable perm value greater than 0.4 that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of said wall at the opening while providing a water barrier to liquid water applied thereto to the sill, jambs and head interior surfaces of a window or door opening in a plurality of bonded strips and to the external sheathing at said sill, jambs and head.

19. The method of claim **18** including additionally applying said sheet material to the exterior surface of the wall surrounding said sill, jambs and head and forming a sealed joint with the material applied to said sill, jambs and head interior surfaces.

20. A seal construction for a nail-on window or door frame, the frame for installation in a window or door opening in a wall, the opening being formed by a horizontal sill, a horizontal head and vertical lambs connecting the sill to the head, the wall at the sill, head and jambs having front and rear faces, the seal construction comprising:

an integral pliable sheet material seal member exhibiting a breathable perm value that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of said opening while providing a water barrier to liquid water applied thereto;

the seal member comprising a first portion for overlying at least a selected portion of one of the head and sill, the sill and head each having opposing first and second ends, a second jamb portion normal to the first portion for overlying at least a portion of a first jamb at the sill first end, a third jamb portion normal to the first portion for overlying at least a portion of a second jamb at the sill second end, first and second corner portions for overlying the junction between said selected one of the head and sill and the respective first and second jambs, and a fourth front face portion normal to the first, second and third portions for overlying at least a portion of the front face of the wall adjacent to the selected one of the head and sill portions and adjacent to the first and second jamb portions.

21. A seal construction for a nail-on window or door frame, the frame for installation in a window or door opening in a wall, the opening being formed by a horizontal sill, a horizontal head and vertical lambs connecting the sill to the head, the wall at the sill, head and jambs having front and rear faces, the seal construction comprising:

an integral unitary pliable sheet material seal member exhibiting a breathable perm value that repels liquid water applied to a surface thereof and which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of said opening while providing a water barrier to liquid water applied thereto;

the seal member comprising a first portion for overlying a portion of one of the head and sill, a second jamb portion normal to the first portion for overlying a portion of the jamb at said one of the head and sill and a third front face portion normal to the first and second portions for overlying the front face of the wall adjacent to the selected one of the head and sill portions and adjacent to the jamb portion wherein the first and second portions form a fourth portion which overlies the junction between the sill portion and jamb portion.

22. The seal construction of claim **21** wherein the first portion is arranged for overlying the entire selected sill or head and further including a fifth portion for overlying at least a portion of a second jamb at the sill second end and normal to the first portion.

23. A method of sealing a window or door opening comprising applying pliable sheet material to at least one of a sill and head and to at least one jamb between the sill and head and to the external wall surface at said at least one sill and head and at said at least one jamb, the material exhibiting a breathable perm value which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of said wall at the opening, said sheet material also for repelling liquid water applied to a surface thereof to provide a water barrier to liquid water applied thereto.

24. The method of claim **23** including the step of applying the material to two jambs at opposite ends of the at least one sill and head and for overlying the junctions between the at least one sill and head and the two jambs.

25. A window seal construction for sealing a window or door opening comprising:

a pliable sheet material arranged for application to at least one of a sill and head and to at least one jamb between the sill and head and to the external wall surface at said at least one sill and head and at said at least one jamb, the material exhibiting a breathable perm value which permits water vapor to permeate therethrough in response to a pressure differential thereacross to preclude substantial condensation collection in the interior of said wall at the opening, said sheet material also for repelling liquid water applied to a surface thereof to provide a water barrier to liquid water applied thereto.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

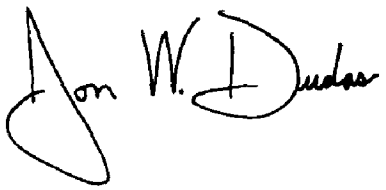
PATENT NO. : 6,725,610 B2
DATED : April 27, 2004
INVENTOR(S) : Colin Murphy et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 15,
Line 28, change "lambs" to -- jambs --

Signed and Sealed this

Twentieth Day of July, 2004



JON W. DUDAS
Acting Director of the United States Patent and Trademark Office

US008555589B2

(12) **United States Patent**
Semmens et al.

(10) **Patent No.: US 8,555,589 B2**
(45) **Date of Patent: *Oct. 15, 2013**

(54) **ROOFING SYSTEM**

(75) Inventors: **Blaine K. Semmens**, Tacoma, WA (US); **Colin R. Murphy**, Seattle, WA (US)

(73) Assignee: **MOS, LLC**, Seattle, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1501 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/332,403**

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

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
E04B 7/00 (2006.01)

(52) **U.S. Cl.**
USPC **52/409**; 52/410; 52/746.11

(58) **Field of Classification Search**
USPC 52/408, 409, 410, 746.11
See application file for complete search history.

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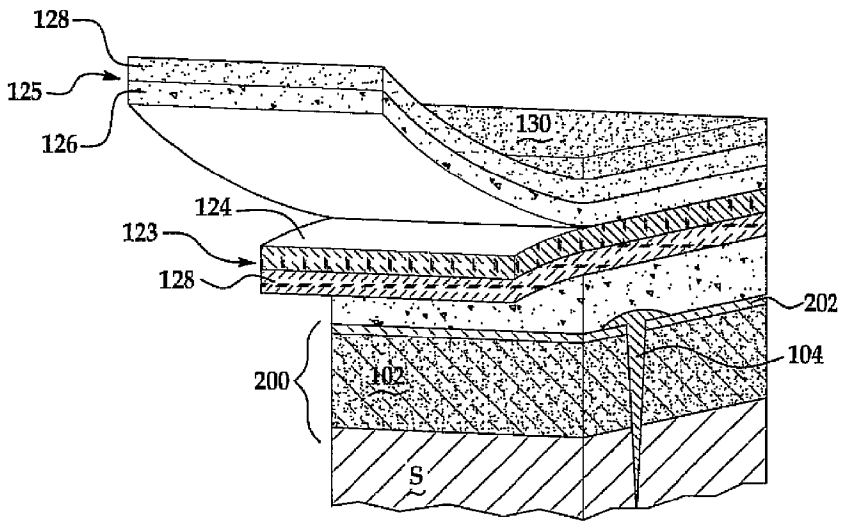
Primary Examiner — Robert Canfield
Assistant Examiner — Brent W Herring
(74) *Attorney, Agent, or Firm* — Blue Filament Law PLLC; Avery N. Goldstein

(57) **ABSTRACT**

A roofing system includes an insulation layer and an exposed fiber surface of a sheet. A cement layer is placed intermediate therebetween. An elastomeric outer weatherproof coating overlies the sheet. A process for applying to a roofing system is provided that includes applying to a roofing substrate an insulation layer having an upper surface. Wet cement is applied on the upper surface of the insulation layer. An exposed fiber surface of a sheet is placed in contact cement. The sheet is then either directly or with intermediate layers therebetween overlayered with an elastomeric weatherproof coating. An insulation board is also provided that includes an exposed fiber backing. The exposed fiber backing accepts an overlayer of elastomer, cement, or mastic.

13 Claims, 4 Drawing Sheets



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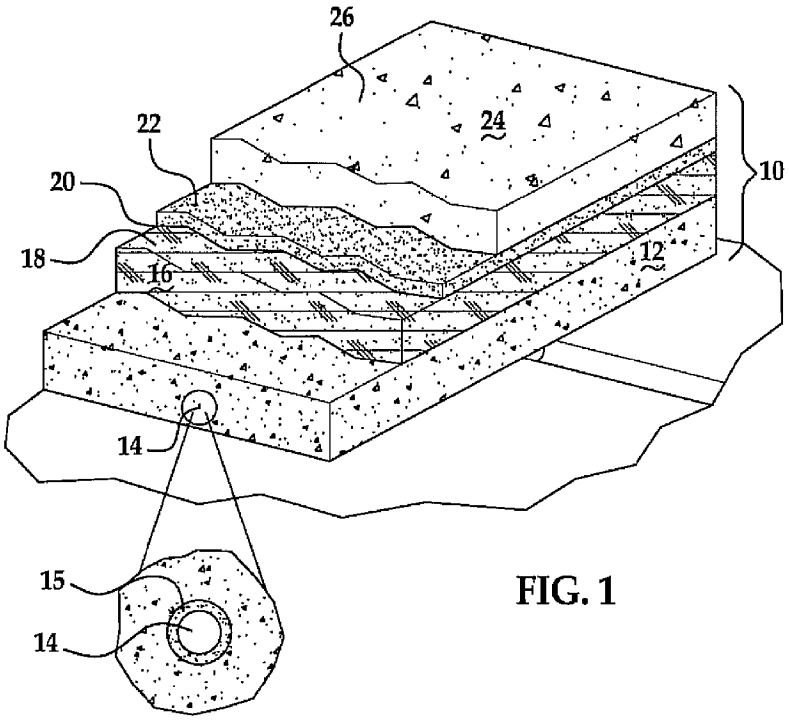

FIG. 1

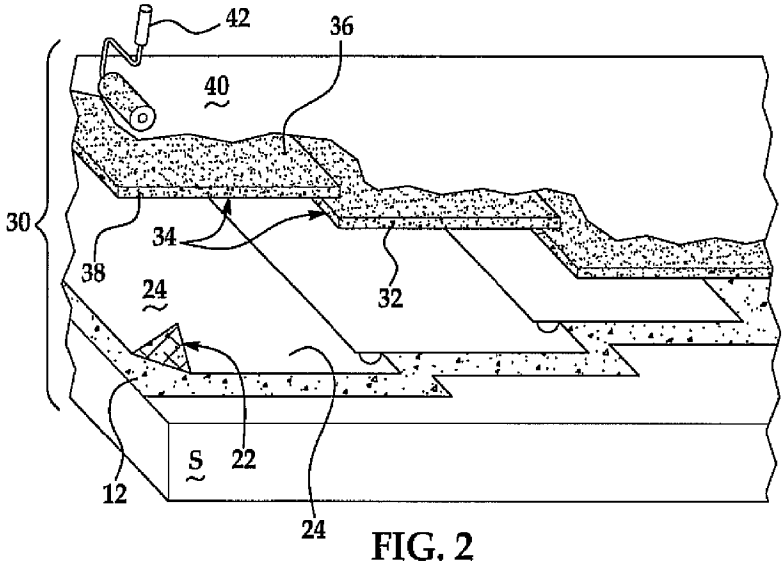

FIG. 2

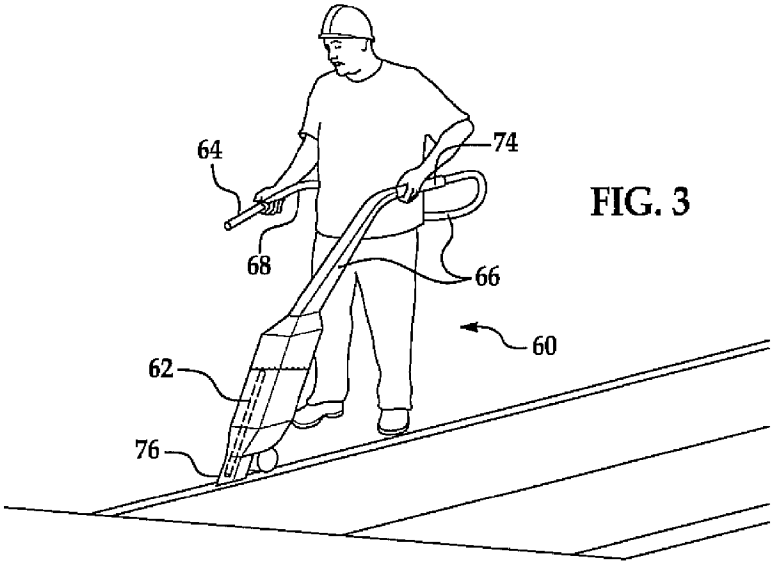
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FIG. 3

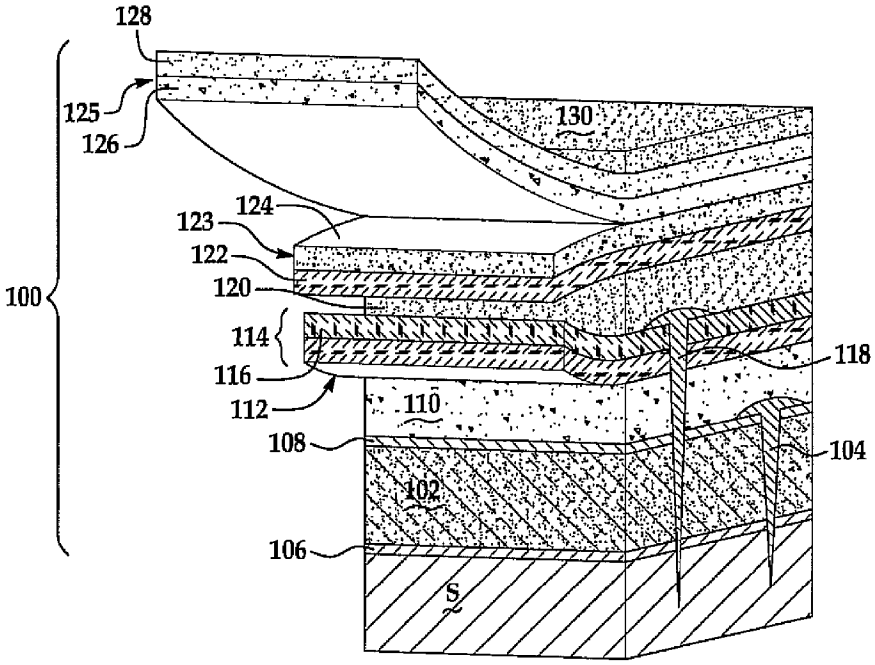
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FIG. 4

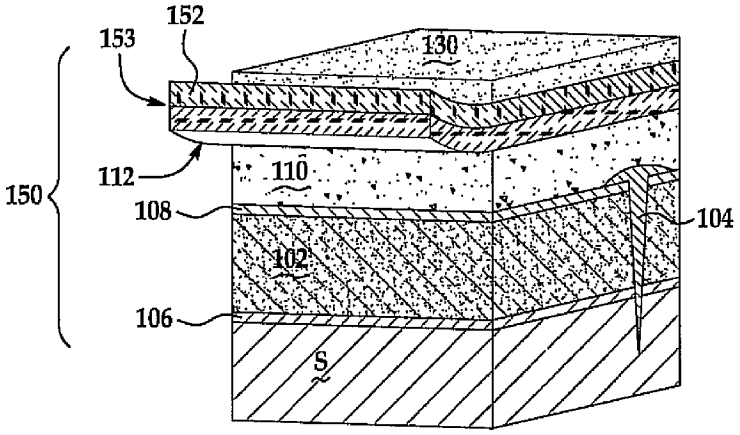

FIG. 5

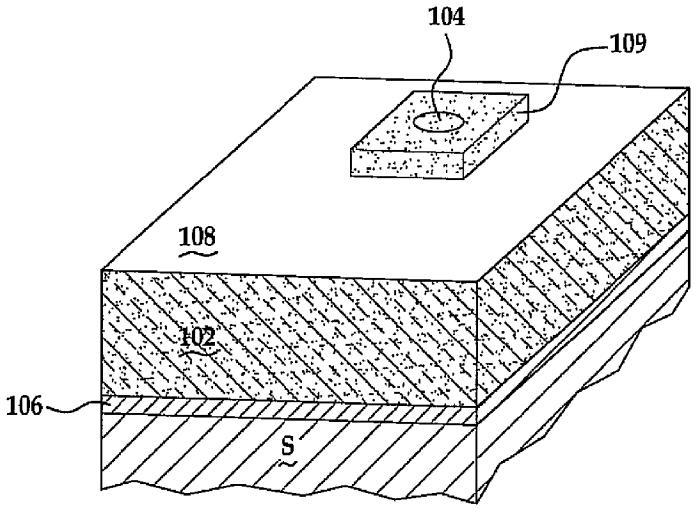

FIG. 6

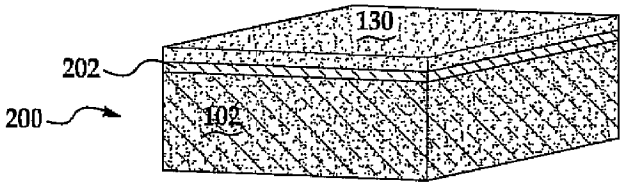

FIG. 7

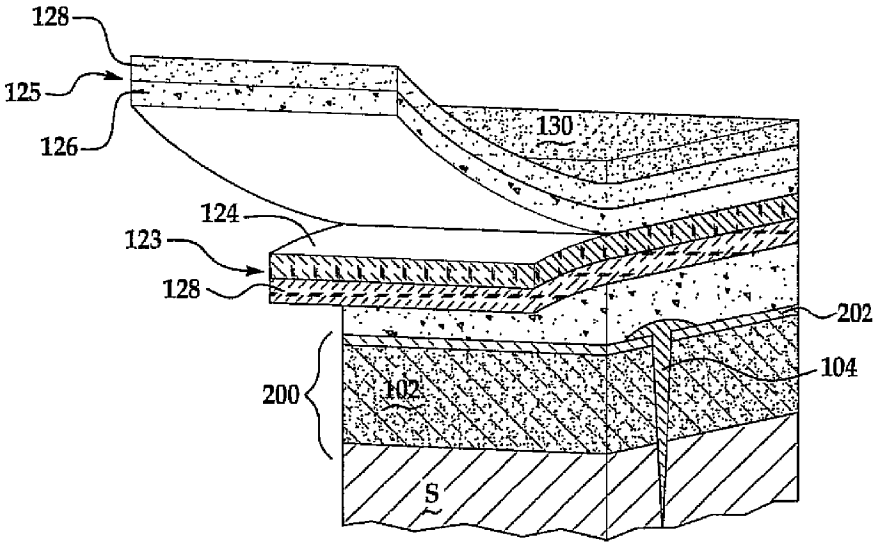

FIG. 8

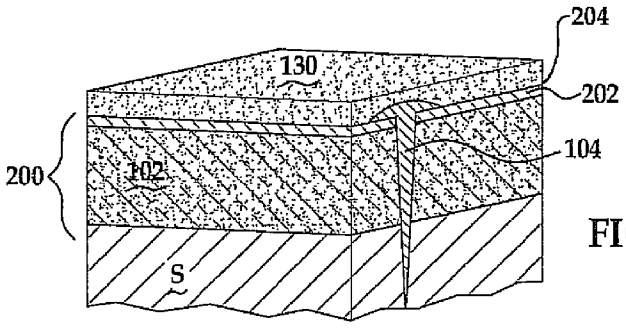

FIG. 9

ROOFING SYSTEM

RELATED APPLICATIONS

This application is a continuation-in-part application of U.S. patent application Ser. No. 11/288,905 filed Nov. 29, 2005, the contents of which are incorporated by reference.

FIELD OF THE INVENTION

The present invention in general relates to low profile roofing systems, and in particular to an exposed fiber layer roofing membrane.

BACKGROUND OF THE INVENTION

Safety concerns and regulations are making the inclusion of fire-resistant boards within a roofing system more commonplace. Currently, structural insulated panels or other prefabricated sheets are used for this purpose. These panels are typically produced from cellulose reinforced cement board as outside skins and applied as a sheathing to a wall or roof section. The fire-resistant properties of such a board are enhanced by application of a layer of calcium sulfate, magnesium oxy-chloride, or asbestos onto the board or forming such a board from magnesium oxy-chloride, while attachment of panels for wall sections is an efficient process owing to the large number of passageways associated with a wall surface. However, in a roofing setting such fire-resistant boards create considerable difficulties associated with transporting heavy and brittle cementitious panels to the point of application. The subsequent operation to cut such panels within industry acceptable tolerances represents a time-consuming and skilled task. Considerable efficiencies in applying fire-resistant low slope roofs could be achieved through the elimination of fire-resistant boards in roofing systems.

Recognition of the societal value of reflectance and emittance standards for roof weatherproofing membrane barriers has created a desire to produce a roofing system with varied properties which is amenable to use in a re-roofing application. While various intermediate layers between a roof substrate and an external membrane have been tried to achieve these standards, these have met with limited success.

Thus, there exists a need for a new roofing intermediate layer that is capable of securing a membrane layer to an overlying membrane. With the use of magnesium oxide based fire-resistant intermediate layer formable in place on a roof surface, the resulting magnesium oxide layer acts as an adhesive towards a variety of component surfaces found in a commercial roofing system including an overlying membrane. Alternatively, an exposed fibrous surface of an intermediate layer asphaltically joined to an underlayer receives an elastomeric overcoat to form a weatherproof roofing system.

SUMMARY OF THE INVENTION

A roofing system includes an insulation layer and an exposed fiber surface of a sheet. A cement layer is placed intermediate therebetween. An elastomeric outer weatherproof coating overlies the sheet. Various layers optionally are provided intermediate between the sheet, such a second cement layer supporting another exposed fiber surface that terminates on the opposing surface with an asphaltic precoating. The asphaltic precoating is readily fused to another asphaltic layer to define a barrier. If the other asphaltic layer has an exposed fiber surface in opposition to the side fused to the asphaltic precoating, an elastomeric weatherproof coating is applied directly thereto.

A process for applying to a roofing system is provided that includes applying to a roofing substrate an insulation layer having an upper surface. A wet cement is applied on the upper surface of the insulation layer. An exposed fiber surface of a sheet is placed in contact cement so that the cement penetrates at least in part the exposed fiber surface. The sheet is then either directly or with intermediate layers therebetween overlayered with an elastomeric weatherproof coating.

An insulation board is also provided that includes an exposed fiber backing. The exposed fiber backing is adherent to the insulation and accepts an overlayer of elastomeric weatherproof coating or a cement adhesive to bond subsequent layers. The interfacial strength created by joining insulation and a fibrous backing serves to enhance the wind stability of the resultant roofing system.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partial cutaway perspective view of a roof system containing an inventive magnesium oxide adhesive;

FIG. **2** is a partial cutaway perspective exploded view of an exposed fiber surface intermediate layer overlayered with an elastomeric coating;

FIG. **3** is a perspective view of an applicator apparatus;

FIG. **4** is a perspective, partially delaminated inventive roofing system embodiment depicted with optional mechanical fasteners in cross section and in which relative thickness of layers has been distorted for illustrative purposes;

FIG. **5** is a perspective, partially delaminated inventive roofing system depicting another embodiment depicted with optional mechanical fasteners in cross section and in which relative thickness of layers has been distorted for illustrative purposes;

FIG. **6** is a perspective view of an inventive system for securing insulation to a roof substrate;

FIG. **7** is a perspective view of an inventive exposed fiber insulation board;

FIG. **8** is a perspective, partially delaminated inventive roofing system further embodiment employing an exposed fiber insulation board of FIG. **7**, depicting with optional mechanical fasteners in cross section and in which relative thickness of layers has been distorted for illustrative purposes; and

FIG. **9** is a perspective inventive roofing system employing an exposed fiber insulation board of FIG. **7** with an elastomer roof coating applied with optional mechanical fasteners in cross section and in which relative thickness of layers has been distorted for illustrative purposes.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention has utility in the formation of an intermediate layer binding a roofing substrate to an overlying weatherproofing membrane. In a preferred embodiment, fire-resistant adhesive is provided for securing a roof system to a cementitious substrate. Alternatively, an intermediate roll material is applied with an asphaltic bottom layer contacting a roof substrate and having an exposed fibrous layer well suited to bond to a bottom surface of an overlying outer membrane. The present invention finds uses in roofing materials, structural coatings, and construction panel fabrication. Through the admixing of particulate or fiber having a dispersing coating thereon to suppress electrostatic attraction and

make the particulate or fiber hydrophilic, a magnesium oxide cement matrix is rendered sufficiently viscous to preclude flow out through voids or openings within a substrate deck level. Such particulate or fiber also has the added benefit of reducing the overall density of the resulting adhesive.

As used herein, a magnesium oxide cement is defined to include magnesium oxy-chloride, magnesium oxy-sulfate and magnesium phosphate where the terms "cement" and "matrix" are used herein synonymously independent of whether particulate or fibers are dispersed therein.

A magnesium oxide cement according to the present invention is loaded with synthetic polymer particulate or fibers. A synthetic polymer particulate or fiber operative herein is a hydrophobic expanded material illustratively including polystyrene, polyisocyanurate, polypropylene, polyethylene, other polyalkylenes and polyurethanes. Preferably, the synthetic polymer is polystyrene. As a result of synthetic polymer particulate grinding and sieving, electrostatic attractions develop therebetween.

A dispersant coating operative herein to suppress electrostatic attraction between synthetic polymer particulate particles includes a wide variety of materials. It is appreciated that such a coating also optionally affords benefits associated with increasing insolubility, plasticity and adjustment of the surface tension of the slurry. A dispersant coating substance operative herein illustratively includes slack lime; magnesium oxide; nonionic asphalt roof emulsion; cationic or anionic asphalt emulsions, such as a road emulsion; ionic styrene butadiene rubber emulsions; neoprene containing emulsions; and combinations thereof. It is preferred that an asphalt emulsion is modified with a like pH modifier, such as a rubber for use herein. Additionally, particulate dispersing coatings are also operative to suppress electrostatic attraction between synthetic polymer particulate. Powder type dispersing coatings operative herein illustratively include water-insoluble carbonates, carboxylic acid salts, oxides and mixed oxides of metals from periodic table groups II, III and/or IV, and specifically include calcium carbonate, magnesium carbonate, barium carbonate, zinc carbonate, magnesium stearate, calcium palmitate, zinc stearate, aluminum stearate, zinc oxide, aluminum oxide, titanium dioxide, silicon dioxide, magnesium silicate, calcium silicate, aluminum silicate, and combinations thereof; insoluble hydroxides such as magnesium hydroxide, calcium hydroxide; magnesium phosphate, fumed silica, type F fly ash; type C fly ash; aluminum sulfate and other insoluble sulfates; and combinations thereof. Preferably, powder dispersing agent only lacks water to create a reactive dispersal. Organic polymeric dispersants operative herein illustratively include a copolymer of polyvinyl chloride with other authentically unsaturated monomers such as vinyl acetate or vinyl alcohol, acrylic resins, polyimides, epoxy resins and ionic detergents. Preferably, the dispersant coating is present from 0.125 to 0.75 pounds per gallon of synthetic polymer particulate. More preferably, the dispersant coating material is present from 0.125 to 0.50 pounds per gallon of synthetic polymer particulate.

A magnesium oxide matrix material surrounds the dispersed particulate. The matrix material is present from 0.5 to 5 pounds per gallon of dispersed particulate. Preferably, the material is magnesium oxy-sulfate. More preferably, the cementitious matrix material is present from 2 to 4 pounds of activated matrix material per gallon of dispersed particulate.

In a preferred process, dispersant coated particulate or fibers are supplied in measured bag quantities, the bagged particulate or fibers being mixed with magnesium oxide cement at the roof application jobsite. The particle or fiber containing magnesium oxide cement upon mixing is amenable to delivery to a roof substrate through pumping or conveying systems conventional to the art. The particulate or fiber material having the dispersant coated pre-applied thereto is readily wet by the magnesium oxide cement. An open-cell foam or high surface area fragmented particulate or fibers are capable of absorbing the surrounding cement matrix slurry and holding the slurry in a mass until matrix set. While the amount of particle or fiber containing magnesium oxide cement slurry applied to a roof surface is largely within the purview of one of skill in the art, typical slurry thicknesses range from one-quarter to one inch. As the slurry is spread, it forms a seamless cementitious densifying layer that seals cracks and voids associated with a substrate. Additionally, it is appreciated that such a layer has considerable adhesive tack at the exposed interface not only to cementitious substrates, but also a variety of laminate layers associated with a conventional low slope roofing system. An additional benefit of an inventive adhesive slurry is affording a fire-resistant layer without resort to the transport and handling of preformed fire-resistant boards.

An inventive intermediate layer is optionally compacted with pressure in areas of lap joints to improve the profile and decrease seam voids where one roof sheet roll overlaps a second such sheet. As the inventive adhesive is applied as a slurry, it fills in voids like pits, fractures and fastener pullouts in concrete and insulation surfaces. The inventive adhesive is optionally extruded into excessive cracks in insulation boards.

A modified version of an inventive formulation is operative to fill low areas that tend to pond water. In such a usage, preferably the particulate is of larger size with a mean particle size of greater than one-quarter inch long axis length or vermiculite. Optionally, the inventive slurry is mixed with surfactant to break the surface tension to afford a particle-rich slurry, compared to the above detailed inventive slurry amenable to wetting hydrophobic surfaces. Preferably, the higher density inventive slurry detailed above overlays this filler to ensure consistent coverage throughout the system. Water diversion from behind small curbed protrusions is also practiced in combination with the dual density adhesive provided.

An inventive intermediate layer upper surface is optionally overlayered with a non-woven fiber mat that is embedded at least in part within the matrix. A partially embedded mat serves as an adhesion surface for an asphaltic membrane layer. Preferably, the fiber mat is completely embedded within the inventive adhesive matrix such that wet cementitious slurry is exposed on the upper surface of the fiber mat, the mat affording modified mechanical properties to the adhesive. Typical fiber mats operative herein include woven and non-woven polyester, glass and polyalkylenes such as polypropylene and polyethylene.

An inventive intermediate layer is applied to roofing substrate by any rotosater driven delivery system. This type of machine applies a ribbon or bead of an inventive slurry in a profile that is regulated by parameters such as pump speed and application wand rate of motion. Compressed air injected at the nozzle affords for even application through repetitive passes as inventive slurry is extruded and contacts a roofing substrate. In a preferred embodiment, a more controlled application apparatus is used. With an extension coupled to the applicator nozzle terminus that bifurcates from the delivery hose orifice into a manifold of smaller orifices, a more uniform and wider ribbon of an inventive slurry is applied. With the use of such a manifold applicator, an inventive slurry is readily extruded right along the top edge of a previously installed roofing membrane sheet without contaminating the lap joint of the roofing membrane sheet with a contacting

second membrane roofing sheet. Additionally, it is appreciated that angling such a manifold tipped applicator wand allows for uniform delivery of an inventive slurry between spaces less than the width of the manifold. Regardless of the particulars of an inventive slurry application, upon spreading an inventive adhesive, the applied adhesive is preferably groomed to a uniform thickness through resort to a heavy roller after spreading a fiber mat and preferably a roofing membrane thereover. The roofing membrane is preferably an elastomeric water-impervious barrier layer.

It is appreciated that the lower surface of such a barrier membrane must grip an inventive intermediate layer to ensure a good bond at the interface. Membrane surfaces well suited for forming good interfacial adhesion with an inventive adhesive include styrene-butadiene-styrene (SBS) polymer modified granular surface sheets inverted and placed into contact with an inventive adhesive. Additionally, a fleece-backed surface of a polyvinyl chloride membrane affords good interfacial bonding. Preferably, conventional membrane is formed with the omission of an asphaltic layer from one side of the base ply leaving an exposed polyester fiber surface amenable to forming a good interface with an inventive magnesium oxide adhesive. Such an asphaltic layer missing membrane achieves sufficient uplift strength while providing an excellent surface for a new membrane application after roof removal. Knife cut strips of the asphaltic layer lacking membrane release with sufficient application of force to induce pull up.

Referring now to FIG. **1**, a partial cutaway of an inventive roof system is depicted generally at **10**. A magnesium oxide slurry **12** contains particulate and/or fibers **14** having a pre-applied dispersant coating **15** thereon to suppress electrostatic attraction and is applied to a substrate S. A woven or non-woven synthetic fiber mat **16** is optionally present. The mat **16** if present is at least partially embedded within the matrix and preferably the upper surface **18** of the fiber mat **16** is wetted with matrix material **20** that has been pressed through the mat **16**. The top layer of matrix material **20** forms an interfacial bond with a lower surface **22** of an elastomeric roof membrane **24**. The interfacial surface **22** of the membrane **24** illustratively includes exposed polyester fiber, an SBS modified granular surface sheet or a fleece-backed polyvinyl chloride membrane. The top surface **26** of membrane **24** is an asphaltic material or modified asphaltic surface such as that obtained by modifying the surface with SBS.

Referring now to FIG. **2**, an alternative roofing system structure is depicted as a partial cutaway exploded view generally at **30**. A rolled roofing material **32** has an asphaltic side **34** contacting a substrate and an exposed non-asphaltic fibrous surface **36**. The asphaltic side **34** forms an interfacial bond with the substrate. While the substrate depicted in FIG. **2** is top surface **26** of the roof system depicted in FIG. **1** at **10**, it is appreciated that any conventional asphalt containing surface, or surface adhesively bondable to asphalt is operative herein. The fibrous surface **36** includes a woven or non-woven synthetic fiber mat extending from an asphaltic layer **38** that terminates in the asphaltic side **34**. The exposed fibrous surface **36** is porous and amenable to receive an elastomeric roof coating **40**, such as conventional polyacrylic containing products. Preferably, the coating **40** is applied with a sponge roller as depicted at **42**. An elastomeric roof coating **40** having a white or silver color is appreciated to provide superior reflectance and emittance values compared to heat absorptive dark colored coatings.

While a thermoset head lap or seam lap is readily applied to a membrane system in a factory process, field applied asphalt or interply adhesive is appreciated to also be operative herein. The preferred method of sealing absent factory thermoset lap formation is the injection of SBS modified asphalt at the proper transition temperature to ensure the fusion of the asphaltic side of a membrane to an exposed polyester side of a previously removed membrane layer lacking a lower asphaltic coating. SBS modified asphalt is so applied with a small rooftop kettle that fills a gravity-fed apparatus with a trigger-operated flow mechanism. Preferably, an applicator tip is designed to slide freely between the laps or the extrusion of material therebetween. Application of SBS modified asphalt to all seams followed by contact with for instance a four inch heavy roller causes fusion of the membrane while compressing the still soft but setting adhesive slurry thereby leveling the profile of the lap. A novel apparatus for application is depicted in FIG. **3** generally at **60**. The apparatus **60** has a heating element **62** that melts pieces, synonymously referred to as charges, of SBS modified asphalt **64** that are inserted into an opening **66** that allows the charge to be forced past the heating element **62** under gravity feed or a pressure source. Preferably, the pieces of SBS modified asphalt **64** are size and shape matched to insert within the opening **66** and as depicted are preferably cylindrical in shape. The heating element **62** is preferably electrically powered via line power **68**. The constant introduction of cold material charges **64** quickly equalizes the temperature of a reservoir **70**. As such, a thermostat can be set to the rate of flow required to inject material into the laps. The reservoir **70** terminates in a tip **72** adapted to insert under a lap and fluid communication to the tip **72** under the control of a handle **74** connected to a valve **76** intermediate between the reservoir **70** and the tip **72**. The applicator **60** is mounted on a wheel **78** that serves to compress just applied asphalt.

Regardless of the method used to seal lap joints between membranes overlying an inventive adhesive, the present invention achieves the following beneficial results. The membrane roll material can be applied bidirectionally so as to in theory double the rate of application by allowing an installer to turn around at an end and apply the material in the opposite direction instead of returning to the starting point as conventional factory installed laps require. Additionally, the end laps of such a membrane overlying an inventive adhesive are reversed for all rainwater flow directions for any situation such as crickets and other slope changes.

Referring now to FIGS. **4** and **5**, inventive roof system is depicted generally at **100** and **150**, respectively, with common elements being identified with like numerals. An insulation material **102** is placed on a roofing substrate S. The roofing substrate S is any conventional roofing structure such as steel decking, plywood, or oriented strand board (OSB). The insulation material **102** is secured to the substrate S by a conventional technique appropriate for the substrate S. By way of example, contact adhesive or mechanical fasteners are well suited for securement of insulation board material **102**. Insulation material **102** is a low density material having a thickness chosen to impart a preselected R-value, based on the insulation board composition. Typical R-values for roofing insulation range from 2 to 10. Compositions from which roof insulation are foams illustratively include polystyrene, polyurethane, and polyisocyanurate. While in a preferred embodiment, the insulation material **102** is a deployed as a prefabricated board, it is appreciated that a foam applied onto a substrate S is also operative herein with the proviso that the foam be sufficiently planar to facilitate buildup of the subsequent layers of the roofing system **100**. It is appreciated that a spray-applied foam is amenable to mechanical planarization after application. More preferably, insulation material **102** in the form of boards is secured to a substrate S with a mechani-

cal fastener **104**, alone or in combination with an adhesive **106** so to enhance the wind stability of an inventive roofing system **100**. Insulation material **102** provided as manufactured boards is provided with an optional backing **108** on one or both faces. The backing **108** in conventional insulation board is a paper or metalized layer. Most preferably, the insulation material **102** has an exposed fiber backing, as detailed with respect to FIG. **7**.

A magnesium oxide cement **110** is applied to a paper layer **106**, if present, or an exposed surface of the insulation material **102** so as to form a layer having a thickness of from 0.1 to 1 inch in thickness. It is appreciated that the cement **110** optionally includes particulate or fiber fillers. Spaced ribbons, expanded polystyrene spheres, and chopped fibers are representative to such inclusions. An exposed fiber surface **112** of sheet **114** is laid into the wet magnesium oxide cement **110** with the net result that cement **110** fills the interstitial spaces between fibers. The fiber sheet **114** or **153** is either woven or non-woven and is formed from a variety of fibers illustratively including fiberglass; polyester; and polyalkylene, specifically including polypropylene geofiber. Preferably, the insulation **102** with the optional paper layer **108**—cement **110** and partially embedded fiber surface **112** of sheets **114** or **153** is fabricated in a factory setting and arranged to tile a roof substrate S.

In regard to FIG. **4**, the opposing surface **116** of the sheet **114** is exposed. Alternatively, the fiber sheet **112** is provided as a rolled material that is unrolled onto the cement **110**. After the cement **110** has set embedding the surface **112**, the sheet **114** is optionally secured to the substrate S with a mechanical fastener **118**.

Regardless of the process by which sheet **114** is applied, an additional layer of magnesium oxide cement **120** is applied to exposed surface **116**. An exposed fiber surface **122** of a sheet **123** is embedded in the cement **120** to allow penetration into the surface **122**. Preferably, the sheet **123** is delivered to a roof situs as a roll. The opposing surface **124** of sheet **123** is precoated with a substance that leaves the surface **122** exposed. The precoating substance is an asphaltic material. A second sheet **125** is overlayered onto surface **124** with an asphaltic surface **126** of the sheet **125** in contact with the surface **124**. The opposing surface is an exposed fiber surface colored coatings.

In regard to FIG. **5**, the precoating substance is an elastomeric coating on surface **152** of sheet **153**. The application of an additional coat of elastomer **130** in the form of a hardening liquid, directly onto surface **152** completes the roof system. The elastomeric roof coating **130** includes conventional polyacrylic containing products. Preferably, the coating **130** is applied with a sponge roller. An elastomeric roof coating **130** having a white or silver color is appreciated to provide superior reflectance and emittance values compared to heat absorptive dark colored coatings.

In a preferred embodiment, an insulation material **102** and an optional paper backing **108** is secured to roofing substrate S as described with respect to FIGS. **4** and **5** by securing a cement soaked fiber layer **109** intermediate between a fastener **104** and the insulation material **102**. The peel strength of the resulting inventive roofing system is thereby enhanced and allowing the roofing system to survive higher prolonged wind gusts. The cement soaked fiber layer **109** is applied either as a continuous sheet underlying multiple fasteners **104** or as discontinuous sections, each of which is secured by a single fastener **104**. The cement soaked fiber layer **109** typically has a thickness of between 1/16 and 1 inch. Preferably the thickness is between 1/16 and 3/8 of an inch. The cement soaked fiber layer **109** serves to limit the deformation the laminate of comparatively soft insulation experiences under high winds upon securement to an underlying substrate. The fiber layer is preferably applied as cement pre-wet, discontinuous sections. More preferably, the discontinuous section has a surface area of at least three times the fastener head surface area. Optionally, the fiber layer pre-wet with cement is allowed to set up prior to driving the fastener therethrough into the underlying insulation and substrate. Additionally it is appreciated that placing a pool of cement beneath a fastnere prior to dringin the fastener entrains some cement in the fastener hole to further improve adhesion. After securement of the laminate of cement soaked fiber layer—insulation to the substrate, additional layers are applied as detailed above with respect to FIGS. **4** and **5** beginning with addition of a cement layer **110**.

An insulation board having an exposed fiber backing is depicted in FIG. **7** generally at **200**, where like reference numerals correspond to those described above with respect to FIGS. **4** and **5**. The insulation board **200** has an insulation layer **102** having an exposed fiber backing **202**. The insulation layer **102** typical has a thickness of between 1 and 6 inches and preferably between 1.5 and 4 inches. The open structure of a fiber layer allows the insulation foam to penetrate the fiber loops on one side during extrusion and allow cement to penetrate the opposing side of the fiber backing. If the foam is open celled, preferably this cement slurry is provided at a viscosity such that it will seep into the open cells of the foam, further enhancing interfacial bond strength. The insulation layer preferably penetrates partially into the fiber backing **202** so as to leave exposed fibers on the upper surface **204**. The exposed fiber backing is typically bare of insulation to a thickness of between 1/32 and 2 inches. Partial insulation penetration into the fiber backing affords resistance against delamination between insulation layer **102** and the backing **202** while allowing an overcoating of cement adhesive or elastomeric coating to wick into the exposed fiber backing **202**. An inventive board **200** is readily formed by pouring a viscous insulation polymer syrup resin over a fiber material with control over syrup resin viscosity or residence time prior to foaming to assure exposed fibers remain on the surface **204**. It is appreciated that the foaming conditions are dictated by the properties of the insulation polymer resin and are known to the art. Alternatively, a pressure adhesive is placed intermediate between a bare insulation surface and a fiber mat to form an inventive board.

The usage of an insulation board having an exposed fiber backing **202** in a roofing system is depicted in FIGS. **8** and **9** where like numerals correspond to those detailed above with respect to FIGS. **4** and **5**. The insulation board has an exposed fiber backing **202** as shown in FIG. **8** and has a cement layer **110** to bond securely to the exposed fiber backing **202** and join the backing **202** to an exposed fiber surface **122** of a sheet **123** having an opposing asphaltic surface **124**. A mechanical fastener **104** or a pressure adhesive intermediate between the insulation layer **102** and a substrate S, or a combination thereof is used to anchor the board **200**. Through resort to the insulation board having an exposed fiber backing **200**, the layers **114** and **120** of the roofing system depicted in FIG. **4** are effectively eliminated. A second sheet **125** is overlayered onto surface **124** with an asphaltic surface **126** of the sheet **125** in contact with the surface **124**. The opposing surface is an exposed fiber surface **128**, comparable to surface **122**. The proximal surfaces **124** and **126** of sheets **123** and **125**, respectively are fused together with a conventional heat source, such as a hot asphaltic applicator or a flame source. The exposed fiber surface **128** is then sealed with a coat of elastomer **130** in the form of a hardening liquid, directly onto surface **128** completes the roof system and additional fabric layers option-

ally interlaced with coating on the seams. The elastomeric roof coating **130** includes conventional polyacrylic containing products. An elastomeric roof coating **130** having a white or silver color is appreciated to provide superior reflectance and emittance values compared to heat absorptive dark colored coatings.

In FIG. **9**, the board **200** is anchored to a substrate S with a mechanical fastener **104**, or a pressure adhesive intermediate between the insulation layer **102** and a substrate S, or a combination thereof. The exposed fiber surface **204** is then sealed with a coat of elastomer **130** in the form of a hardening liquid, directly onto surface **204** seals the system. It is appreciated that a board **200** in a vertical orientation also serves as a wall substrate with a plaster, cement, or mastic being applied to the exposed fiber surface **204**.

The foregoing description is illustrative of particular embodiments of the invention, but is not meant to be a limitation upon the practice thereof. The following claims, including all equivalents thereof, are intended to define the scope of the invention.

The invention claimed is:

1. A roofing system comprising:

an insulation layer;

a woven or non-woven synthetic fiber mat having an exposed fiber surface, said mat having an opposing surface to the exposed fiber surface;

a magnesium oxide cement layer in simultaneous contact with said insulation layer and the exposed fiber surface of said mat, said mat partially embedded in said cement layer with the exposed fiber surface embedded into said cement layer; and

an elastomeric outer weatherproof coating overlying the opposing surface of said mat; and

an elastomeric precoating on the opposing surface to the exposed fiber surface of said mat, said elastomeric precoating in contact with said elastomeric outer weatherproof coating.

2. The system of claim **1** further comprising an asphaltic precoating on the opposing surface of said mat, said asphaltic precoating fused to a second asphaltic precoating on a second mat, said second mat having a second exposed fiber surface amenable to receive said elastomeric outer weatherproof coating.

3. The system of claim **1** wherein said cement further comprises dispersant coated particles or fibers therein.

4. The system of claim **3** wherein said dispersant coated particles or fibers are hydrophobic expanded material coated with a dispersant coating substance.

5. The system of claim **3** wherein said cement is present from 0.5 to 5 pounds per gallon of said dispersant coated particles or fibers.

6. The system of claim **1** wherein said insulation layer is a board.

7. The system of claim **1** further comprising a fastener securing a cement soaked fiber layer and said insulation layer to a substrate.

8. The system of claim **1** wherein said cement is magnesium oxy-chloride, magnesium oxy-sulfate or magnesium phosphate.

9. A roofing system comprising:

an insulation layer;

a first woven or non-woven synthetic fiber mat having a first exposed fiber surface, said first mat having a first opposing surface to the first exposed fiber surface;

a magnesium oxide cement layer in simultaneous contact with said insulation layer and the first exposed fiber surface of said first mat, said first mat partially embedded in said cement layer with the first exposed fiber surface embedded into said cement layer;

an elastomeric outer weatherproof coating overlying the first opposing surface of said first mat;

a second cement layer intermediate between the opposing surface of said mat, and a second woven or non-woven synthetic mat having a second exposed fiber surface, said second woven or non-woven synthetic mat having a second asphaltic precoating in opposition to the second exposed fiber surface, the second asphaltic precoating fused to a third asphaltic precoating on a third woven or non-woven synthetic mat, said third mat having a third exposed fiber surface amenable to receive an elastomeric outer weatherproof coating; and

an elastomeric precoating on the opposing surface to the exposed fiber surface of said mat, said elastomeric precoating in contact with said elastomeric outer weatherproof coating.

10. The system of claim **9** wherein said cement further comprises dispersant coated particles or fibers therein.

11. The system of claim **10** wherein said dispersant coated particles or fibers are hydrophobic expanded material coated with a dispersant coating substance.

12. The system of claim **9** further comprising a fastener securing a cement soaked fiber layer and said insulation layer to a substrate.

13. The system of claim **9** wherein said cement is magnesium oxy-chloride, magnesium oxy-sulfate or magnesium phosphate.

* * * * *

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(45) Date of Patent: *Aug. 13, 2019

(54) **SILL PAN**

(71) Applicant: **EXTERIOR RESEARCH AND DESIGN, L.L.C.**, Seattle, WA (US)

(72) Inventor: **Colin R. Murphy**, Seattle, WA (US)

(73) Assignee: **EXTERIOR RESEARCH AND DESIGN, L.L.C.**, Seattle, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 206 days.

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(60) Provisional application No. 61/878,442, filed on Sep. 16, 2013.

(51) **Int. Cl.**

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E06B 1/70	(2006.01)
E06B 7/14	(2006.01)
B21D 11/10	(2006.01)
B21D 28/00	(2006.01)

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

CPC ***E06B 1/62*** (2013.01); ***B21D 28/00*** (2013.01); ***E06B 1/70*** (2013.01); ***E06B 1/702*** (2013.01); ***E06B 7/14*** (2013.01); *B21D 5/16* (2013.01); *B21D 11/10* (2013.01); *E06B 2001/628* (2013.01); *Y10T 29/49623* (2015.01)

(58) **Field of Classification Search**

CPC E06B 2001/628; E06B 1/70–705; E06B 7/14; E06B 1/62; E06B 1/64; E06B 1/68; B21D 5/00; B21D 5/16; B21D 11/10; B21D 53/74; Y10T 29/49623

See application file for complete search history.

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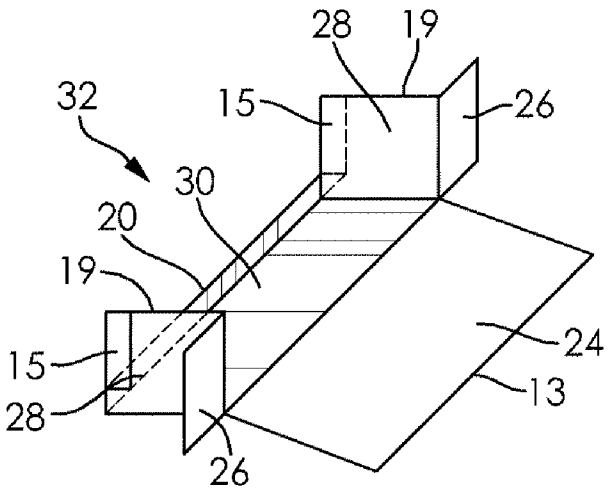
Primary Examiner — Matthew P Travers

(74) *Attorney, Agent, or Firm* — Avery N. Goldstein; Blue Filament Law

(57) **ABSTRACT**

A method for forming a sill pan is provided that includes the measurement of a width and length of an opening sill to be sealed. A piece of flexible sill pan material is cut based on the measured opening sill. Fold lines and cuts are created in the piece to form the sill pan. The resulting sill pan is readily formed to have at least one attribute of self-adherence, draining without shims, nail hole self-sealing, and provision of dams without resort to frame cutting.

7 Claims, 1 Drawing Sheet



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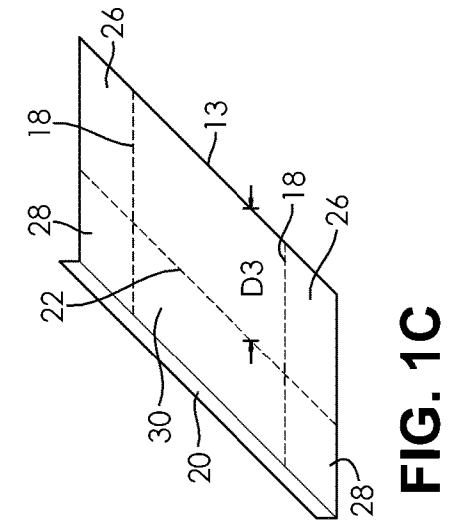

FIG. 1C

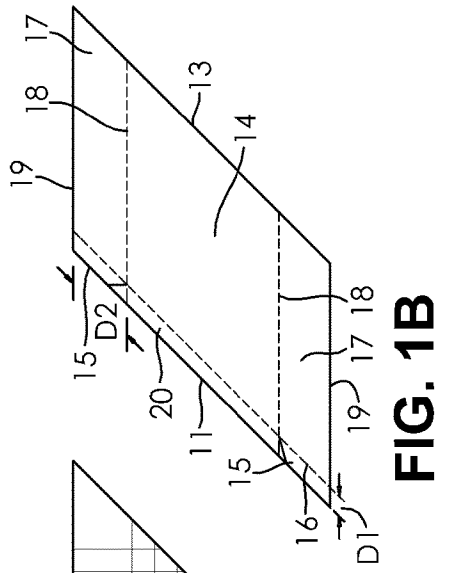

FIG. 1B

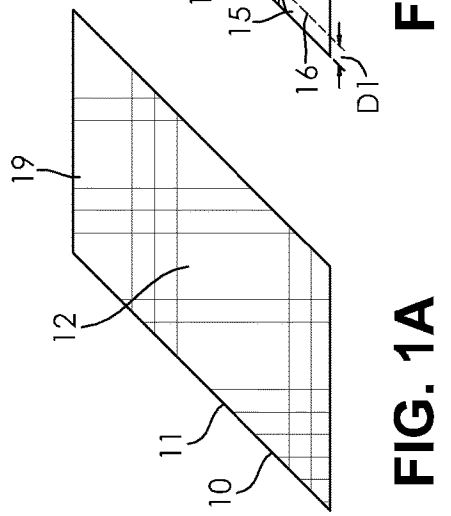

FIG. 1A

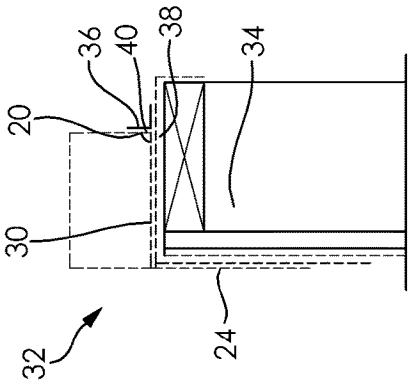

FIG. 2

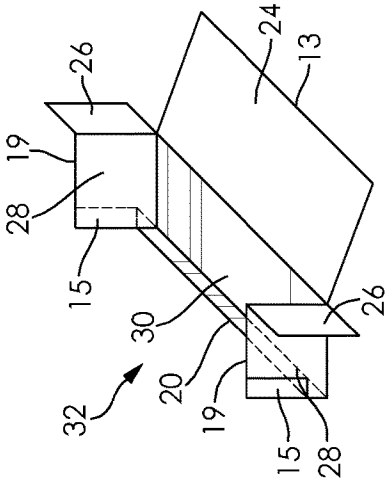

FIG. 1D

SILL PAN

RELATED APPLICATIONS

This application is a continuation of U.S. Non-provisional application Ser. No. 14/487,850 filed Sep. 16, 2014 that in turn claims priority benefit of U.S. Provisional Application Ser. No. 61/878,442 filed Sep. 16, 2013; the contents of which are hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention in general relates to building products for weatherproofing window and door installations and in particular, to a sill pan adapted to waterproof a sill surface and a method for forming the sill pan.

BACKGROUND OF THE INVENTION

The incursion of unwanted air and/or moisture into buildings and homes around door and window joints is a major concern for builders, property owners, and occupants. The penetration of air and/or moisture is a serious concern, and may result in exterior and interior damage if not prevented or corrected in a timely manner. In addition, heat losses caused by air leakage around building openings have taken on new significance due to today's high energy costs. Sealing such openings has typically been accomplished by caulking or using putty-like compound around openings between door and window frames to seal the gaps and prevent inward seepage of air and/or water into a building.

An existing approach to sealing window joints is the use of a sill pan to flash windows into a window opening. The sill pan is typically made of metal and is formed in an off-site fabrication shop based on measurements made of the opening at the building site. Typically, there are variations in the size for each window so each pan is somewhat unique. Furthermore, if the measurement is not precise, the pan will not fit correctly, and must be remade or swapped around to make sure the sill pans fit each opening. An additional problem with metal sill pans is that sill pans create a thermal short from outside to inside of the window to be sealed due to the pans large mass, and creates condensation on the inside of the window at the sill.

A recent more common practice is the use of polyvinyl chloride (PVC) for sealing panels for windows. The PVC is made in two pieces that slide so they can be used in residential applications, which have become more common. The PVC based sill pans slide to fit the opening and are then sealed with glue or sealant to make a watertight assembly. The PVC based products can have built-in shims and other elements to create a slope for directing water drainage. The PVC material is usually thicker than metal. However, plasticized PVC can also have compatibility problems with bitumen based membranes. Furthermore, the PVC based sill product has openings at the point of connection of the two pieces that can be prone to leakage. Both the aluminum and plastic sill pans need to be bonded to the underlying surface so no water can pass underneath, which is typically achieved with non-skinning butyl beads or tapes.

A further trend has been the increased use of vinyl windows in recent years. However, it has generally been recognized that vinyl windows take in water and can leak at the sills notwithstanding the weep holes built into the frame at the sill. Therefore, the use of vinyl windows has significantly increased the use of sill pans, not just flashing membranes. Many manufacturers now encourage the use of

sill pans. An available option is to create a pan from a self-adhered membrane cutting it to fit. A self-adhered membrane that is cut to fit has the advantage of sealing to the underside of the window and forming the product in the field that it is not rigid. The self-adhered membrane will not allow drainage since the window will create a seal unless shims are put under the window to create sufficient space to create drainage. Many manufacturers of vinyl windows want the window to be fully supported which means shims do not work with their vinyl window designs. Furthermore, the membrane is not very durable and the cutting of the membrane can create joints and pinholes that must be filled with sealant to make sure a seal is created.

While many materials and approaches for sealing window and door joints have been tried, there still exists a need for a material and method of application that can be used for a sill pan that has the advantages of a self-adhered membrane, but can drain without shims, and has sufficient sealing materials to seal around nail holes, while being thin enough to properly function and provide end and back dams without cutting the material.

SUMMARY OF THE INVENTION

A method for forming a sill pan is provided that includes the measurement of a width and length of an opening sill to be sealed. A piece of flexible sill pan material is cut based on the measured opening sill. Fold lines and cuts are created in the piece to form the sill pan. The resulting sill pan is readily formed to have at least one attribute of self-adherence, draining without shims, nail hole self-sealing, and provision of dams without resort to frame cutting.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A-**1**D illustrate a method for forming a sill pan from a sheet material according to embodiments of the invention; and

FIG. **2** is a side perspective cut away view of an installed sill pan according to embodiments of the invention.

DESCRIPTION OF THE INVENTION

The present invention has utility for sealing window and door joints and provides a material and method of forming and application of the seal that can be used for a sill pan that has the advantages of a self-adhered membrane, but can drain without shims, and has sufficient sealing materials to seal around nail holes, while being thin enough to properly function and provide end and back dams without cutting the material.

Embodiments of the inventive sill pan may be formed from a waffled aluminum membrane that has a thick butyl backed adhesive on the back, or other materials that inhibit moisture and can be used in the inventive method of forming sill pans. The waffled aluminum membrane is sold as a roll good that can be cut with scissors. The roll goods can be taken to an application or construction site and cut to size as required. In the inventive method for forming a sill pan, instead of cutting and sealing to form the pan, the material is folded to form the end and back dams so there is no hole or bonded surface. In the inventive method, the end dams and back dams of a sill pan may be formed to any required height. In forming the sill pan, the waffled aluminum membrane material is rigid enough to stand up by itself, so that the majority of a backing may be removed leaving the last one-inch, so the material can be turned up when the sill trim

at the back of the window interior is installed. Alternatively in an embodiment, the back dam may be formed with a metal angle to which the back dam can be immediately bonded creating a free standing back dam. The waffle pattern on the face of the aluminum membrane creates a drainage course. If water were to travel through the window the pan will pick it up. The waffle pattern in the membrane material allows the water to drain to the exterior without putting the window to be sealed on shims. The pan can be sloped by gently sloping the sill framing or adding a continuous wood 'chair' with very gentle sloping. The thick butyl backing of the membrane material acts to seal around penetrations. The aluminum surface is compatible with all materials currently in use as a flashing material. Packaged as a rolled good, the aluminum membrane allows for the expansion of the sill to the exterior to any amount the installer requires.

In installations where metal sills are usually exposed, embodiments of the inventive sill pan are more appropriate for a 'nail-on' window that used to be sealed with a nailing flange on all four sides. The concept used by builders today is to leave the sill open to allow and water that enters to drain out instead of entering the building, but to avoid air from entering the building to create an exterior air barrier. The waffled aluminum membrane material achieves the desired sealing performance by allowing drainage at the bottom, and sealing the window to the back dam with a butyl or polyurethane seal. Self-adhered membranes typically have a polyethylene face that serves as a water impervious barrier, and is not a good surface for sealant bonding. However, while the aluminum face of the waffled aluminum membrane material, used in embodiments of the inventive sill pan, also has a zero perm it still also provides a good sealing surface. The aluminum membrane is thick enough to provide rigidity, but thin enough to cut with scissors and to create a thin profile.

Referring now to the figures, FIGS. **1A-1D** illustrate an inventive method for forming a sill pan **32**. It is noted that a waffled or dimpled aluminum membrane is the material used in the example embodiment shown; however additional sheet materials may be used to carry out the inventive method. In FIG. **1A**, a rectangular sheet of flexible sill pan material **10** with the dimple or waffle side **12** showing is laid out and cut to a required size for a window sealing application. In general the inner **11** and outer **13** edges are along the long dimension of the cut sheet **10**. In FIG. **1B**, the smooth surface **14** of the flexible sill pan material **10** is shown, and the surface is measured and marked as follows with a first fold line **16** that defines the height of a back dam **20** at a first distance measured from the inner edge, and a second fold line **18** that defines a rectangular area **17** on opposing sides of the flexible sill pan made up of folded segments **26** and **28** (see FIG. **1C**) that define side flaps and the end dams, respectively. The first fold line **16** is parallel to the long side of the rectangular sheet **10**. The pair of second fold lines **18** are perpendicular to the first fold line **16** and are parallel to short side dimension of the sheet **10** at a second distance (D**2**) measured from the side edges **19**. In FIG. **1C**, a third fold line **22** is added that is parallel to the first fold line **16** at a third distance (D**3**) as measured from the outer edge, and bisects the sheet **10**. Fold line **22** defines the width of the seat **30** of sill pan **10** for seating the window frame, and the downward flap **24** that extends down the wall **34** (see FIG. **2**) below the window sill. The fold along third fold line **22** also creates a drip edge. Additionally in FIG. **1C**, the back dam **20** is folded upward along fold line **16** relative to the seat **30**. In FIG. **1D**, a cut is made along second fold lines **18** that extend from the outer edge **13** until the third fold line **22**, and the segments **26** and **28** that form the side flaps and the end dams, respectively are bent upward and perpendicular to the seat **30**. The side flaps **26** are subsequently bent away from the seat **30** and made perpendicular to the end dams **28**. The opposing ends **15** of back dam **20** that are defined by the area between the inner edge **11**, first fold line **16**, and second fold lines **18** are folded upward after a small cut is made to first fold line **16** that extends from the side edges **19** to the second fold line **18**. The upward opposing ends **15** seal against the end dams **28**. The entire sill pan **32** formed above is now ready to be placed in the opening for the window sealing application.

FIG. **2** is a side perspective cut away view of an installed sill pan **32** in a building wall opening **34** prior to placement of a window frame (not shown) according to embodiments of the invention. As shown the downward flap **24** extends down the wall **34**. Metal angle **36** provides vertical support to back dam **20**, and seat section **30** of the flexible sill pan **32** fits onto the sill **38** of the window opening. A toe bead of sealant **40** is placed at the right angle bend between the seat **30** and back dam **20**. When placing the window frame the bottom rear edge of the window frame is set into the toe bead of sealant **40**.

The invention claimed is:

1. A method for forming a sill pan, said method comprising:

measuring a width and length of an opening sill to be sealed;

cutting a rectangular piece of flexible sill pan material based on the measured opening sill, said sill pan material having a first surface, a second surface opposite to the first surface, an inner edge, an outer edge, and a pair of side edges, where the inner edge and the outer edge are parallel to each other and perpendicular to the side edges of the flexible sill pan material;

creating a set of fold lines in said rectangular piece of flexible sill pan material to define a back dam along the inner edge, a downward flap along the outer edge, and a seat between said back dam and said downward flap of the sill pan;

placing said seat on the sill;

vertically supporting said back dam with a metal angle; and

placing a toe bead of sealant at a fold line between said seat and said back dam

wherein creating said set of fold lines comprises: creating a first fold line on said first surface that defines a height of said back dam at a first distance measured from the inner edge;

creating a set of two second fold lines on said first surf ace that are perpendicular to said first fold line and are parallel to said side edges at a second distance measured from both of said side edges; and

creating a third fold line on said first surface parallel to said first fold line at a third distance as measured from the outer edge that defines a width of said seat of said sill pan for seating a window frame, and said downward flap.

2. The method of claim **1** wherein said second surface of said flexible sill pan material is waffled or dimpled.

3. The method of claim **1** wherein said flexible sill pan material is an aluminum membrane.

4. The method of claim **1** wherein said flexible sill pan material comprises a butyl backed adhesive.

5. A method for forming a sill pan, said method comprising:

measuring a width and length of an opening sill to be sealed;

cutting a rectangular piece of flexible sill pan material based on the measured opening sill, said sill pan material having a first surface, a second surface opposite to the first surface, an inner edge, an outer edge, and a pair of side edges, where the inner edge and the outer edge are parallel to each other and perpendicular to the side edges of the flexible sill pan material, and where the second surface of said flexible sill pan material is waffled or dimpled;

creating a set of fold lines in said rectangular piece of flexible sill pan material to define the sill pan, wherein creating said set of fold lines comprises creating a first fold line on said first surface that defines a height of a back dam at a first distance measured from the inner edge, creating a set of two second fold lines on said first surface that are perpendicular to said first fold line and are parallel to said side edges at a second distance measured from both of said side edges, and creating a third fold line on said first surface parallel to said first fold line at a third distance as measured from the outer edge that defines a width of a seat of said sill pan for seating a window frame, and a downward flap;

cutting said set of two second fold lines that extend from the outer edge until the third fold line; and

cutting said first fold line from opposing sides from said side edges until said second fold lines to form opposing ends.

6. The method of claim 5 further comprising:

folding said first fold line upward to create the back dam that is perpendicular to said seat; and

folding said set of two second fold lines upward to form two side flaps and end dams that are perpendicular to said seat.

7. The method of claim 6 further comprising:

bending said side flaps outward and perpendicular to said end dams; and

bending said opposing ends upward to seal against said end dams.

* * * * *