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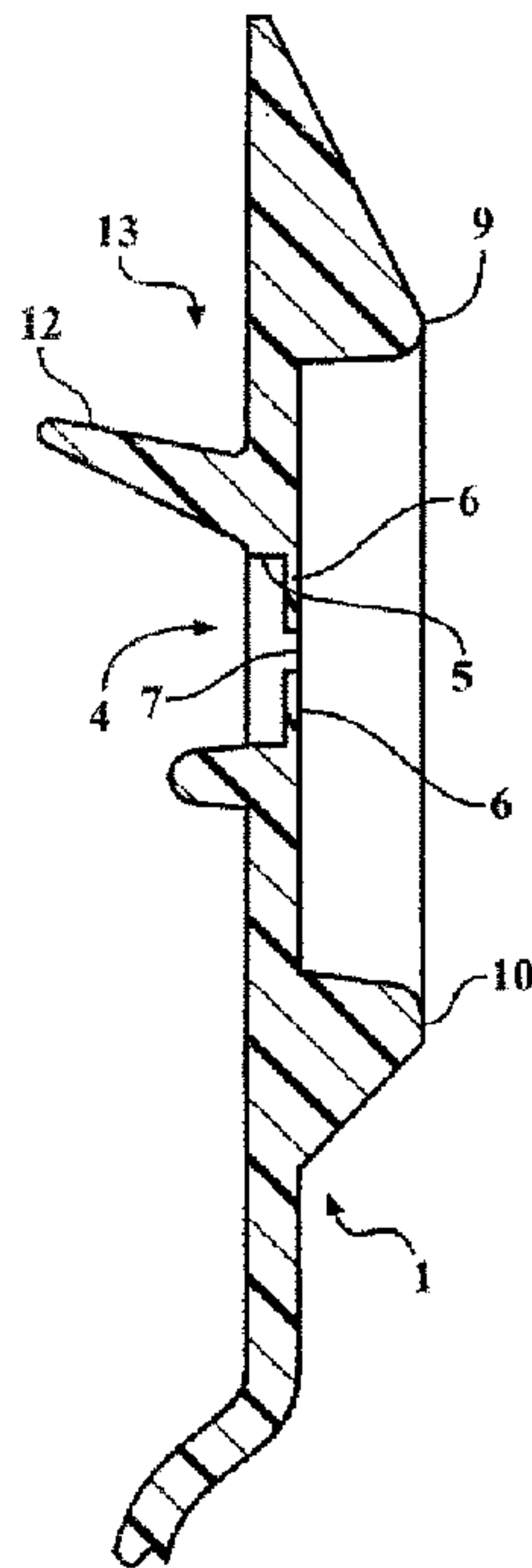
(72) Inventeurs/Inventors:
 GAUDREAU, MICHEL, CA;
 LAGLOIRE, FRANCOIS, CA;
 ALARIE, GUILLAUME, CA;
 BILODEAU, RENE, CA;
 GAUDREAU, LOUIS-ANDRE, CA

(73) Propriétaire/Owner:
 DERBY BUILDING PRODUCTS INC., CA

(74) Agent: ROBIC

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 VERS L'ARRIERE

(54) Title: POLYMER BUILDING PRODUCT WITH REARWARDLY EXTENDING STAND-OFF



(57) Abrégé/Abstract:

A polymer roofing or siding panel having a length, comprising: a front, outwardly-facing decorative surface and an opposite, rearwardly facing surface, a top edge and a vertically spaced-apart bottom edge; a first stand-off positioned proximate the top edge of the roofing or siding panel, the stand-off projecting rearwardly from the rearwardly facing surface, and the stand-off engageable with a substrate to define a gap between the siding or roofing panel and a substrate in the area immediately above the stand-off; a hook positioned proximate the bottom edge of the roofing or siding panel and projecting from the rearwardly facing surface thereof, the hook opening toward the bottom edge of the roofing or siding panel so as to be slidingly receivable in the gap defined in a like, vertically adjacent roofing or siding panel.

ABSTRACT

In polymer building products, such as polymer siding, polymer roofing, j-blocks, gable vents, etc., characterized by fastener apertures each comprising an elongate slot bounded by a peripheral wall defining the slot, the peripheral wall having a height, a fastener centering-guide comprising a layer of material extending into the elongate slot from the peripheral wall thereof, the layer of material having defined therein (a) an elongate opening that is generally parallel to, but of smaller transverse dimensions than, the elongate slot, and (b) a predetermined location, defined intermediate the length of the elongate opening, for receiving a fastener therethrough, and wherein further the layer of material is characterized by a thickness that is less than the height of the peripheral wall and sufficiently thin so as to permit relative movement between a fastener extending through the centering guide and the polymer building product.

POLYMER BUILDING PRODUCT WITH REARWARDLY EXTENDING STAND-OFF

FIELD OF THE INVENTION

The present invention pertains to the field of polymer building products, such as, for example, siding, roofing, J-blocks, gable vents, siding joints, etc., and more particularly to an improved, polymer siding joint for concealing the opposing lateral edges of horizontally adjacent pieces of polymer siding, improved means for ensuring the accurate and facile installation of siding and roofing panels, as well as a fastener centering-guide and a hammer stop for incorporation into polymer building products.

10 BACKGROUND

While the advent of polymer building products has greatly eased the installation of roofing, siding and trim components, drawbacks remain.

To facilitate their installation, polymer building products, such as, for example, siding, roofing, J-blocks, gable vents, etc., are usually characterized by a plurality of fastener apertures each comprising an elongate slot of constant width bounded by a peripheral wall defining the slot. In these regards, the disclosure of the applicant's own prior-published application, US Pub. No. 20080083186, is exemplary. In installation, a fastener, such as a nail, for instance, is driven through each slot and into a substrate to thus secure the building product in place. The slots are elongate so that once a fastener is positioned therein and secured to the underlying substrate, the building products can slide relative to the

fasteners as the polymer material expands and contracts due to changing ambient temperatures.

Necessarily, the fasteners must be positioned approximately in the middle of each slot in order to permit the unfettered relative movement of the building products in either direction so as to accommodate both contraction and expansion of the building products. Unfortunately, hasty installation can lead to the misplacement of fasteners too close to one or the other end of these slots. When this occurs, the slot end confronts the fastener prematurely during its relative movement, leading to unwanted buckling of the building product.

Another common occurrence during installation of polymer building products is for fasteners to be driven too deeply into the substrate, such that the building product is effectively fixed in position and unable to move relative to the fastener in response to changes in the ambient temperature. As with misplacement of the fastener within the slot, this installation error can lead to unwanted buckling of the building product.

Still a further problem in the installation of polymer siding and roofing panels is the need to ensure proper alignment of vertically adjacent rows of siding or roofing panels as they are "stacked" one on top of the other. With conventional polymer roofing and siding panels, it is possible to misalign vertically successive panels relative to the preceding, vertically lower one, unless due care is taken by the installer. However, such due care can slow the installation process.

A further drawback of polymer siding is that the necessity, in some installation methods, of leaving a slight gap between horizontally adjacent panels (to ensure sufficient room for the panels to expand and contract due to changes in ambient temperature) creates an unsightly aesthetic to the thus-finished building. While siding-joints are known as a satisfactory means for concealing such gaps, the conventional forms of these joints are difficult to install.

SUMMARY OF THE DISCLOSURE

The present invention addresses the foregoing problems of the prior art in the provision of improvements to polymer building products, such as polymer siding, polymer roofing, j-blocks, gable vents, etc.

According to a first aspect of the invention, there is provided a fastener centering-guide comprising a layer of material extending into the elongate slot from the peripheral wall thereof, the layer of material having defined therein (a) an elongate opening that is generally parallel to, but of smaller transverse dimensions than, the elongate slot, and (b) a predetermined location, defined intermediate the length of the elongate opening, for receiving a fastener therethrough, and wherein further the layer of material is characterized by a thickness that is less than the height of the peripheral wall and sufficiently thin so as to permit relative movement between a fastener extending through the centering guide and the polymer building product.

According to one feature, the predetermined location for receiving a fastener through the layer of material comprises an opening of a first size, and the

elongate opening comprises a pair of slots extending oppositely from the opening, each slot being characterized by smaller transverse dimensions than the opening.

The layer of material may be formed of polymer, for example, and may be formed
5 integrally with the peripheral wall or as a separate element that is fixedly secured to the peripheral wall.

In another aspect thereof the invention comprises a siding joint for concealing the gap between opposing lateral edges of horizontally adjacent pieces of siding, the siding joint having a bottom portion adapted to be secured to a substrate
10 beneath, and proximate the opposite lateral edges of, horizontally adjacent pieces of siding; and a top portion connectable to the bottom portion so as to capture therebetween horizontally adjacent pieces of siding, the top portion concealing the opposing lateral edges of horizontally adjacent pieces of siding.

Per one feature, the top portion comprises an outwardly-facing surface simulating
15 the appearance of a natural siding material.

Per another feature, the top and bottom portions comprise interlocking elements by means of which the top portion is connectable to the bottom portion.

Per another feature, the bottom portion is a generally wedge-shaped element that tapers in thickness along a longitudinal axis thereof.

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Per another feature, the bottom portion is a generally wedge-shaped element that tapers in thickness along a longitudinal axis thereof.

5 According to a still further feature, the bottom portion comprises a plurality of spaced openings therein. At least one locking tab extends into each said opening. Further according to this feature, the top portion comprises a plurality of rigid supports corresponding in number to the number of the plurality of openings in the bottom portion, each said rigid support terminating in a foot engageable by
10 the at least one tab in the corresponding opening.

According to yet another feature, the bottom portion comprises a plurality of laterally spaced-apart deformable or frangible projections dimensioned to abut the opposing lateral edges of horizontally adjacent pieces of siding. The projections are adapted to be deformable or frangible in response to the force of
15 a siding panel's lateral edge acting against the projections during expansion of the panel as occasioned by changes in ambient temperature.

Per still another feature, the bottom portion further comprises a plurality of laterally extending ribs dimensioned to be able to support overlying siding.

According to a further aspect thereof, the invention comprehends a hammer stop
20 for limiting the depth to which a fastener may be driven into each elongate slot comprising the fastener apertures of a polymer building product. The hammer stop comprises vertically elevated, rigid stop surfaces, the stop surfaces

positioned about each elongate slot so as to confront the face of a hammer having a head diameter greater than the distance between the stop surfaces, and the stop surfaces being vertically elevated above each elongate slot by a distance sufficient to prevent a fastener from being driven into the slot to a depth
5 at which the building product is prevented from moving relative to the fastener during expansion and contraction of the building product.

Per one feature thereof, the hammer stop comprises a pair of elongate ribs disposed oppositely of the elongate slot and longitudinally extending in a direction generally parallel to the longitudinal axis of the elongate slot.

10 Per still another feature, the fastener apertures are disposed serially along a length of the building product, and wherein the improvement further comprises the pair of elongate ribs extending continuously and generally coextensively with the fastener apertures.

In another aspect thereof, the invention comprehends a polymer roofing or siding
15 panel, comprising a front, outwardly facing decorative surface and an opposite, rearwardly facing surface, a top edge and a vertically spaced-apart bottom edge; a first stand-off positioned proximate the top edge of the roofing or siding panel, the stand-off projecting rearwardly from the rearwardly facing surface, and the stand-off engageable with a substrate to define a gap between the siding or
20 roofing panel and a substrate in the area immediately above the stand-off; and a hook positioned proximate the bottom edge of the roofing or siding panel and projecting from the rearwardly facing surface thereof, the hook opening toward

the bottom edge of the roofing or siding panel so as to be slidably receivable in the said gap defined in a like, vertically adjacent roofing or siding panel.

Per one feature of the invention, the first stand-off is a continuous element extending generally coextensively with the length of the roofing or siding panel.

- 5 Per another feature, the hook is defined by a rearwardly projecting element that terminates in a portion extending downwardly toward the bottom edge of the roofing or siding panel.

According to still another feature, the hook is a continuous element extending generally coextensively with the length of the roofing or siding panel.

- 10 According to yet another feature, the hook is a discrete element disposed along the length of the roofing or siding panel.

Per a still further feature, a plurality of discrete hooks are disposed along the length of the roofing or siding panel.

BRIEF DESCRIPTION OF THE DRAWINGS

- 15 The present invention may be better understood with reference to the written description and drawings, of which:

FIG. 1 comprises a rear plan-view of a section of a polymer building product according to the present invention;

FIG. 2 comprises a detailed view of a portion of the building product of FIG. 1;

- 20 FIG. 3 is a cross-section of the building product of FIG. 2, taken along lines 3;

FIG. 4 comprises a front plan-view of the building product of FIG. 1;

FIG. 5 depicts in lateral view the top and bottom portions of the siding joint according to the instant invention;

FIG. 6 is a cross-sectional view of the siding joint of FIG. 5;

5 FIG. 7 is a front view of the top portion of the siding joint of FIG. 5;

FIG. 8 is a rear view of the top portion of the siding joint of FIG. 5;

FIG. 9 is a front view of the bottom portion of the siding joint of FIG. 5;

FIG. 10 is a rear view of the bottom portion of the siding joint of FIG. 5;

10 FIG. 11 is a front view showing the bottom portion of the siding joint of the present invention in position beneath the edges of laterally adjacent pieces of polymer siding (one of which is shown entirely in phantom lines);

FIG. 12 is a rear view showing the bottom portion of the siding joint of the present invention in position beneath the edges of laterally adjacent pieces of polymer siding (one of which is shown entirely in phantom lines);

15 FIG. 13 is a rear plan-view showing the engagement of vertically adjacent siding panels according to the present invention; and

FIG. 14 is a cross-sectional view of the siding panels of FIG. 13, taken along lines 14.

DETAILED DESCRIPTION

As required, detailed embodiments of the present invention are disclosed herein. However, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The accompanying drawings are not necessarily to scale, and some
5 features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present invention.

Referring now to the drawings, wherein like numerals refer to like or
10 corresponding parts, the present invention will be seen to most generally comprise improvements to polymer building products, such as polymer siding, polymer roofing, j-blocks, gable vents, etc. According to a first such improvement, shown in FIGS. 1 through 4, there is provided a fastener centering-guide for facilitating the proper positioning of fasteners (e.g., nails) within each fastener
15 slot so that subsequent relative movement of the building product in response to changes in ambient temperature is possible. More particularly according to the illustrated embodiment, there is provided a polymer siding panel 1 having a rear surface 2 (FIG. 1) facing inwardly toward a substrate (not shown) and a front, outwardly-facing decorative surface 3 (FIG. 4). To facilitate securement of the
20 panel 1 to the substrate, there are provided a plurality of fastener apertures (indicated generally at 4). Viewed from the rear surface 2 (FIGS. 1 and 2) as well as in cross-section (FIG. 3), each such aperture 4 will be seen to comprise,

according to convention, an elongate slot bounded and defined by a peripheral wall 5.

Referring more particularly to FIGS. 2 and 3, a fastener centering-guide is further provided within the area of each slot defined by the wall 5, the centering-guide
5 generally comprising a layer of material 6 extending or protruding into the elongate slot from the peripheral wall 5. The layer of material 6 has defined therein an elongate opening 8 that is generally parallel to, but of smaller transverse dimensions than, the elongate slot defined by the wall 5. Elongate opening 8 may be defined by a slit in the layer of material or, as desired, by a slot
10 of transverse dimensions.

Further defined in the layer of material intermediate the length of the elongate opening 8 is a predetermined location 7 for receiving a fastener, such as, for instance, a nail (not shown), therethrough. In the illustrated embodiment, this predetermined location 7 is depicted as an opening the dimensions of which are
15 sufficient to permit the shank of a fastener such as a nail to pass freely therethrough. According to this embodiment, the elongate opening 8 is a slot characterized by smaller transverse dimensions than the opening of location 7 so as to thereby distinguish the preferred approximate location for positioning a fastener.

20 It will be appreciated that the dimensions of the location 7 may be smaller or larger than as shown, subject only to the need for the location 7 to clearly identify for an installer the preferred approximate location for positioning a fastener within

the slot defined by the wall 5. Thus, for instance, it is contemplated that the location 7 may simply comprise indicia, such as an "X," positioned along the length of the elongate opening 8 for identifying the preferred position for the fastener to be driven into the layer of material.

5 Referring specifically to FIG. 3, the layer of material 6 will be seen to be characterized by a thickness that is less than the height of the peripheral wall 5. This thickness of the layer of material 6 is sufficiently thin so as to permit relative movement between the fastener (not shown) extending through the centering guide and the polymer building product, as occasioned by changes in ambient
10 temperature which cause expansion and contraction of the polymer material of the building product.

Further to the illustrated embodiment, the layer of material 6 is a polymer which may be formed with the siding panel 1 or other building product so as to be integral therewith. Alternatively, the layer of material 6 may be formed separately
15 and subsequently fixed in place, such as with adhesives, over the elongated slots. It will also be appreciated that the layer of material need not be formed of polymer, being formed instead, for example, from fabric, cellulose, etc.

According to a second improvement to building products encompassed by the present disclosure, also shown in FIGS. 3 and 4, there is provided a hammer
20 stop for limiting the depth to which a fastener may be driven into each elongate slot defined by the peripheral wall 5, thereby preventing the building product from being fixed immovably in place against the substrate. Generally, the hammer

stop comprises vertically elevated, rigid stop surfaces 9, 10 positioned about each elongate slot (defined by the peripheral wall 5) so as to confront the face of a hammer having a head diameter greater than the distance between the stop surfaces 9, 10.

- 5 According to the illustrated embodiment of FIGS. 3 and 4, in which the hammer stop is shown in conjunction with siding panel 1, the rigid stop surfaces 9, 10 of the hammer stop define a pair of elongate ribs disposed oppositely of the fastener apertures 4 and longitudinally extending in a direction generally parallel to the longitudinal axis of each elongate slot (defined by the peripheral wall 5).
- 10 Each stop surface 9, 10 is further defined in cross-section (FIG. 3) as a raised shoulder extending the length of the panel 1 generally coextensive with the series of fastener apertures 4. The vertical distance between each stop surface 9, 10 and the elongate slot defined by peripheral wall 5 is such as to ensure that, during installation of the building product (e.g., the siding panel 1) with a hammer
- 15 having a head diameter greater than the distance between the opposing stop surfaces 9, 10, a fastener can be driven through the slot and into the underlying substrate only so far as to a depth which leaves sufficient space for the building product to move relative to the fastener during expansion and contraction.

Referring next to FIGS. 5 through 12, a further improved building product

20 according to the present disclosure comprises a polymer siding joint for concealing the gap between opposing lateral edges of horizontally adjacent pieces of siding, the siding joint comprising a bottom portion 20 adapted to be

secured to a substrate beneath, and proximate the opposite lateral edges of, horizontally adjacent pieces of siding (1 and 1' in FIGS. 11 and 12), and a top portion 30 connectable to the bottom portion 20 so as to capture therebetween horizontally adjacent pieces of the siding 1, 1', the top portion 30 concealing the
5 opposing lateral edges of horizontally adjacent pieces of siding.

Referring more specifically to FIGS. 5 through 8, the top portion 30 comprises a generally planar member having a front, outwardly-facing decorative surface 31 which may be fashioned to match the appearance of the outwardly-facing decorative surfaces of the siding panels. For instance, the outwardly-facing
10 surface 31 may simulate the appearance of a natural siding material, such as wood. This generally planar member of the top portion is, as indicated, at least of sufficient dimensions in both width and length so that, in use (described hereafter), it substantially conceals the opposing lateral edges of horizontally adjacent pieces of siding and the gap which must of necessity be left
15 therebetween during installation so as to permit expansion of the siding due to changes in ambient temperature.

From the rear, inwardly facing surface 32 there project a plurality of rigid supports 33 interconnected at their bases by a rib 34. The end of each support 33 terminates in a generally planar foot 35 oriented substantially normal to the
20 support. As depicted best in FIG. 5, each foot 35 is characterized on either side of the support 33 by a forward edge 36 which slopes upwardly toward the rear surface 32, then terminating abruptly in a surface 37 disposed generally perpendicular to the plane of the foot 35.

Referring next to FIGS. 5, 6, 9 and 10, the bottom portion 20 is, in profile (FIGS. 5 and 6), a generally wedge-shaped member the taper of which corresponds to the taper of the polymer siding installed thereover. One or more recessed or counter-bored openings 21 are provided through the bottom portion 20, each opening 21 dimensioned to receive therethrough a fastener (e.g., a nail) whereby the bottom portion may be fixed to a substrate. As shown in the exemplary embodiment, openings 21 are offset relative to the longitudinal centerline of the bottom portion 20, being disposed, more particularly, proximate the right hand side of the bottom portion as shown.

10 Extending laterally from the bottom portion 20 are a plurality of ribs 22 dimensioned to support the rear surface of siding lying thereover.

Openings 23 corresponding approximately in shape to each of the feet 35 are also provided through the bottom portion 20. Extending into each such opening 23 at the forward portion thereof are a pair of locking tabs 24 separated by an elongated opening 25. Two of the three openings 23 are further characterized by the presence of a stop surface 26 as best shown in FIGS. 6 and 9.

Referring specifically to FIGS. 5 and 9, the upper surface of the bottom portion 20 further includes several projections 27. As shown, the projections 27 are disposed in laterally spaced-apart pairs. Each such projection 27 extends upwardly a sufficient distance so as to abut the opposing lateral edges of horizontally adjacent pieces of siding panel during installation thereof, as explained further below. Each such projection 27 is preferably fabricated so as to

be either frangible or deformable in response to the force of a siding panel's lateral edge acting against the projection 27 during expansion of the panel as occasioned by changes in ambient temperatures.

Turning now to FIGS. 11 and 12, the manner of employment and operation of the
5 inventive siding joint will be better understood.

According to convention, rows of siding panels (e.g., 1, 1') are installed on a substrate (not shown) in horizontally-adjacent fashion, with a sufficient distance left between the opposing edges of horizontally-adjacent panels so as to accommodate thermal expansion of these panels following securement thereof to
10 the substrate. Following placement and installation of a first siding panel 1, the bottom portion 20 is positioned and installed on the substrate proximate the lateral edge of the siding panel 1. To facilitate such installation, the installer positions the bottom portion 20 against the substrate (not shown) and partially beneath the siding panel 1 so that the lateral edge of the siding panel abuts the
15 nearest of the pairs of projections 27. To further facilitate precise placement of the bottom portion 20, there may, as shown in FIG. 12, be provided one or more stops 11, stand-offs or the like on the rear surface 2 of each siding panel which are adapted to contact the top edge of the bottom portion 20, as depicted.

Following placement, fasteners are driven through the off-set openings 21 to fix
20 the bottom portion 20 to the substrate. Thereafter, the next horizontally adjacent siding panel 1' is positioned and installed. Positioning relative to the bottom portion 20 is again facilitated using the projections 27, with the lateral edge of the

siding panel 1' being arranged so as to abut the nearest of the pairs of such projections 27.

After the siding panel 1' is fixed in place on the substrate, the top portion 30 (not depicted in FIGS. 11 and 12) is mated to the bottom portion 20. This is
5 accomplished by positioning the top portion proximate the bottom edges of the siding panels 1, 1' such that the front, outwardly-facing decorative surface 31 is disposed above the front surface 3, 3' of each siding panel 1, 1', the supports 33 are aligned with the gap G defined between the adjacent, installed siding panels 1, 1', and the feet 35 are positioned beneath the rear surface (not shown) of each
10 siding panel 1, 1'. Thereafter, the top portion 30 is slid upwardly toward the bottom portion 20 until each of the feet 35 is positioned above a corresponding one of the openings 23. The top portion 30 is then urged downwardly until the feet 35 confront stop surfaces 26, whereupon the top portion 20 is urged upwardly once more to force tabs 24 over the forward edge 36 of each foot 35
15 and into locking engagement against the surface 37.

Referring next to FIGS. 3, 13 and 14, a further improved building product according to the present disclosure comprises the provision of a unique profile for siding panels (1, 1"), as depicted, or roofing panels, which permits such panels to be easily and accurately positioned vertically-adjacent each other. As shown best
20 in FIGS. 3 and 14, there is provided proximate the top edge of each siding panel 1, positioned above the elongate slot defined by peripheral wall 5, a rearwardly projecting stand-off 12 which serves to contact the substrate upon installation of the siding and so maintain between the siding panel 1 and the substrate a gap 13

defined in the area immediately above the stand off 12. Along the length of the siding panel 1 the gap 13 defines, upon installation of the siding panel, an upwardly-opening channel. But while the stand-off 12 is shown as a continuous element extending generally coextensively with the length of the siding panel, it will be understood that a plurality of discrete ones of such stand-offs may instead be provided, each positioned along the length of the panel.

Referring particularly to **FIG.14**, there is provided, proximate the bottom of each siding panel 1, a rearwardly projecting element **14** which terminates in a downwardly extending portion **15** to define, in cross-section, a substantially "L"-shaped hook. This element **14** may extend continuously across the length of the siding panel 1, or, alternatively, may be formed as one of a plurality of discrete ones of such elements positioned along the length of the panel.

In operation, which may be best understood with reference to **FIG. 14**, a first siding panel 1 is installed against a substrate **S**, with the stand-off **12** defining the gap **13** in the area above the stand-off **12** and between the top edge of the siding panel and the substrate. In placing the next vertically-adjacent siding panel 1, an installer simply slides the panel 1 downwardly towards the previously installed panel 1 until the downwardly extending portion **15** of element **14** is received in the gap **13** and abuts against the stand-off **12**, thus indicating accurate placement of the panel 1 relative to the panel 1. The panel 1 may then be fixed in place against the substrate and the siding panel installation process repeated.

It will be appreciated from the foregoing disclosure that the present invention provides polymer building products which facilitate the accurate and rapid installment thereof.

Of course, the preceding specification is merely illustrative of the present
5 invention, and those of ordinary skill in the art will appreciate that many additions and modifications to the present invention, as set out in this disclosure, are possible without departing from broader aspects of this invention as defined in the appended claims.

CLAIMS

1. A polymer roofing or siding panel having a length, comprising: a front, outwardly-facing decorative surface and an opposite, rearwardly facing surface, a top edge and a vertically spaced-apart bottom edge; a first stand-off positioned proximate the top edge of the roofing or siding panel, the stand-off projecting rearwardly from the rearwardly facing surface, and the stand-off engageable with a substrate to define a gap between the siding or roofing panel and a substrate in the area immediately above the stand-off; a hook positioned proximate the bottom edge of the roofing or siding panel and projecting from the rearwardly facing surface thereof, the hook opening toward the bottom edge of the roofing or siding panel so as to be slidingly receivable in the gap defined in a like, vertically adjacent roofing or siding panel.
2. The polymer roofing or siding panel of claim 1, wherein the first stand-off is a continuous element extending coextensively with the length of the roofing or siding panel.
3. The polymer roofing or siding panel of one of claims 1 and 2, wherein the hook is defined by a rearwardly projecting element that terminates in a portion extending downwardly toward the bottom edge of the roofing or siding panel.
4. The polymer roofing or siding panel of claim 3, wherein the hook is a continuous element extending coextensively with the length of the roofing or siding panel.
5. The polymer roofing or siding panel of claim 3, wherein the hook is a discrete element disposed along the length of the roofing or siding panel.

6. The polymer roofing or siding panel of claim 5, wherein a plurality of discrete hooks are disposed along the length of the roofing or siding panel.

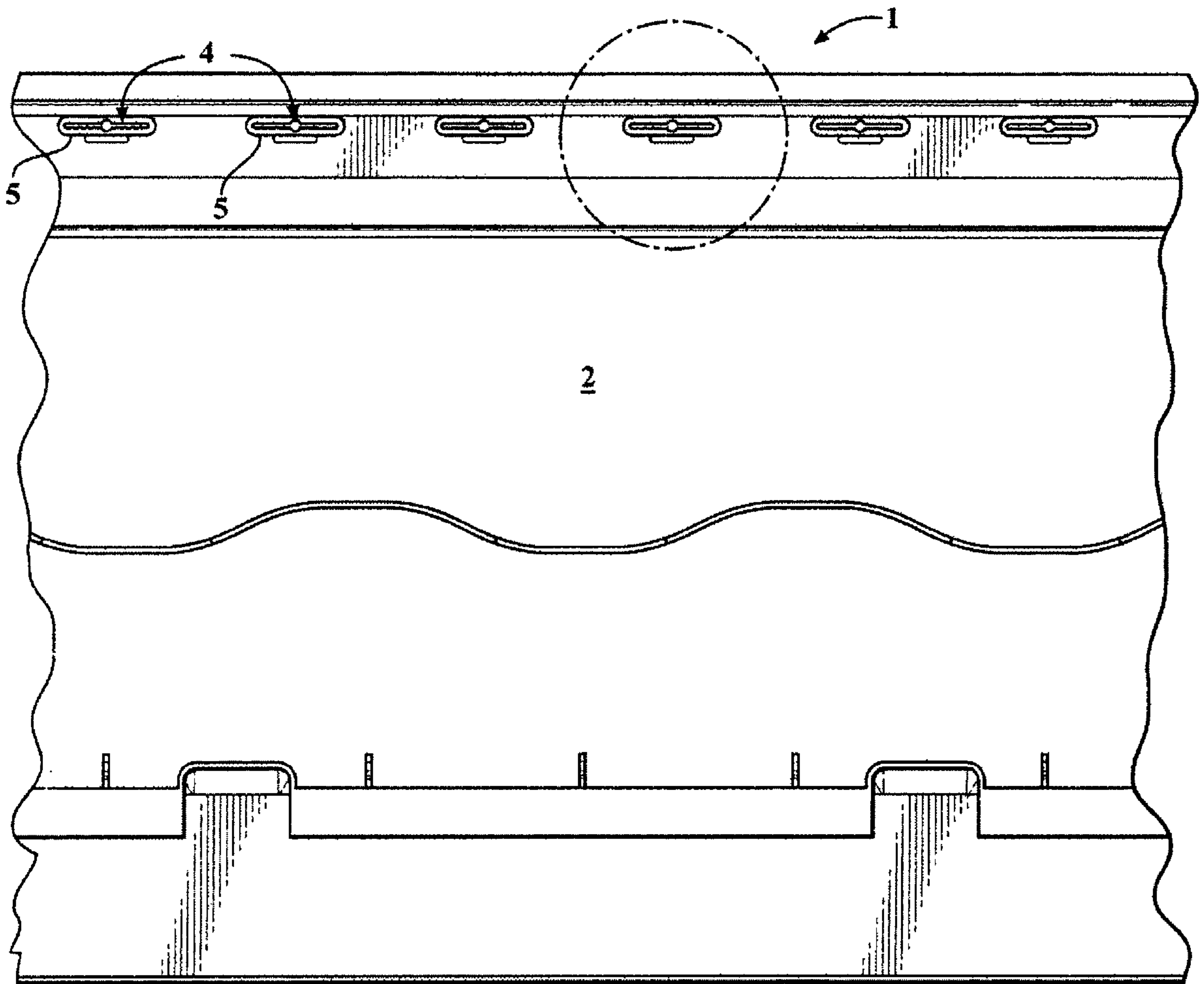


FIG. 1

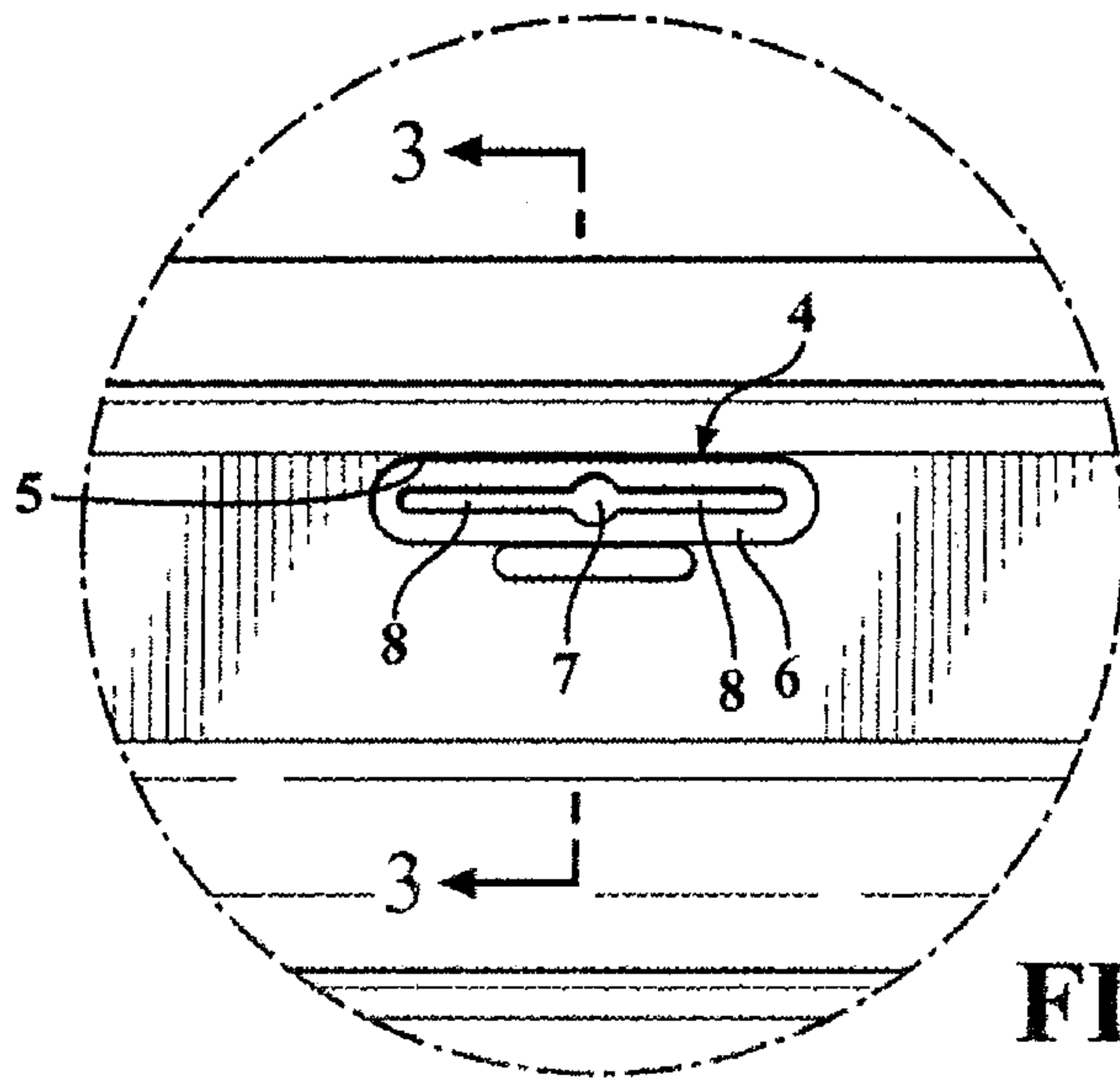


FIG. 2

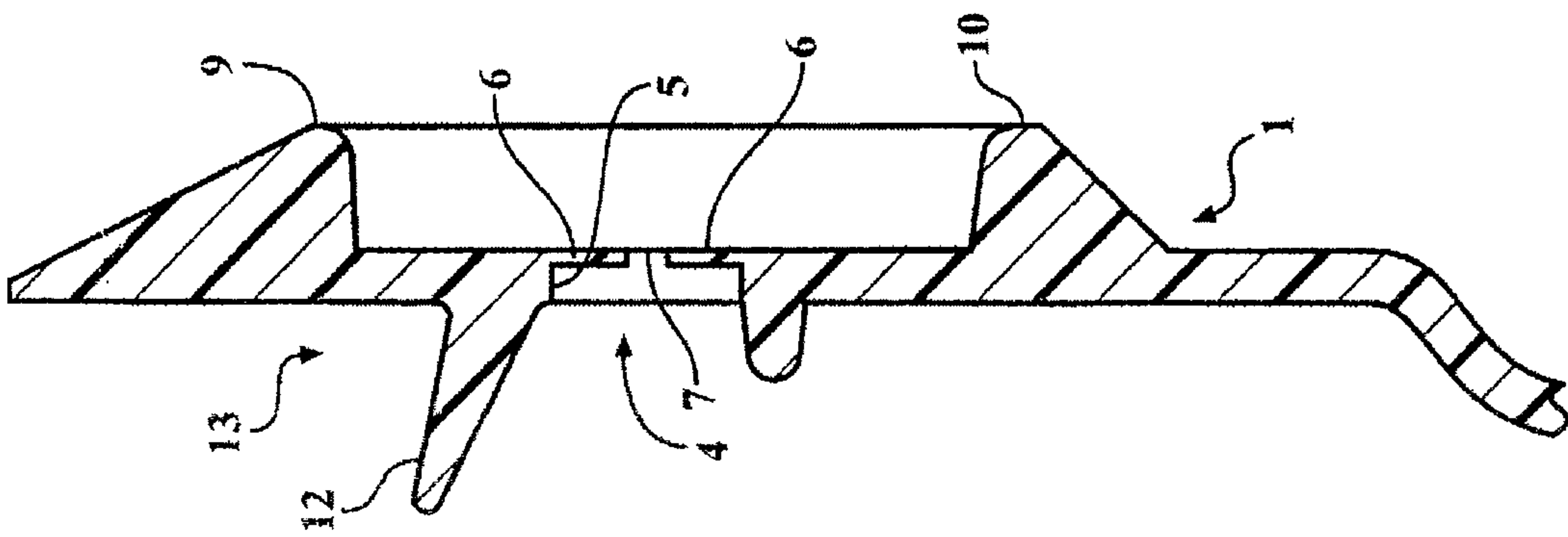


FIG. 3

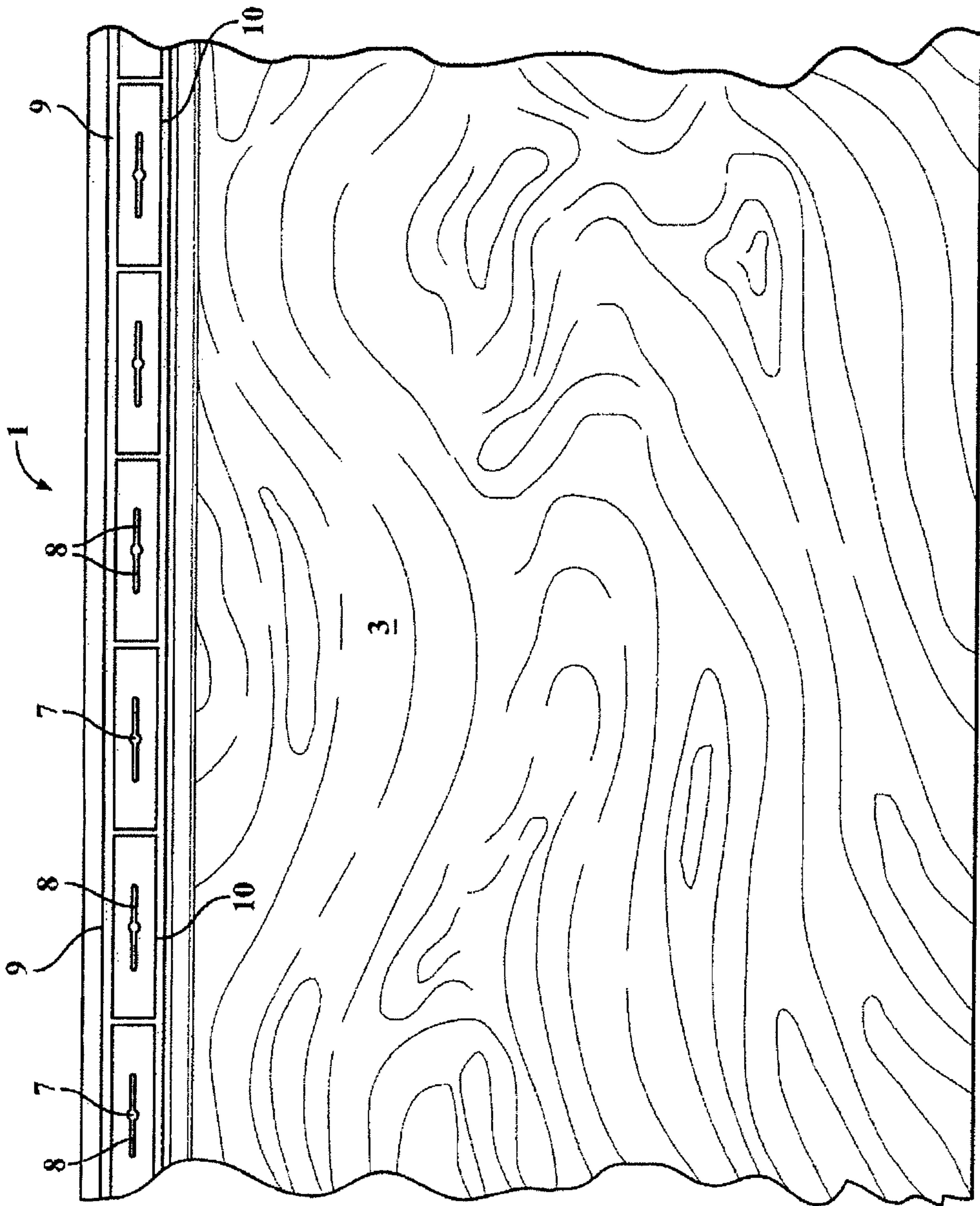


FIG. 4

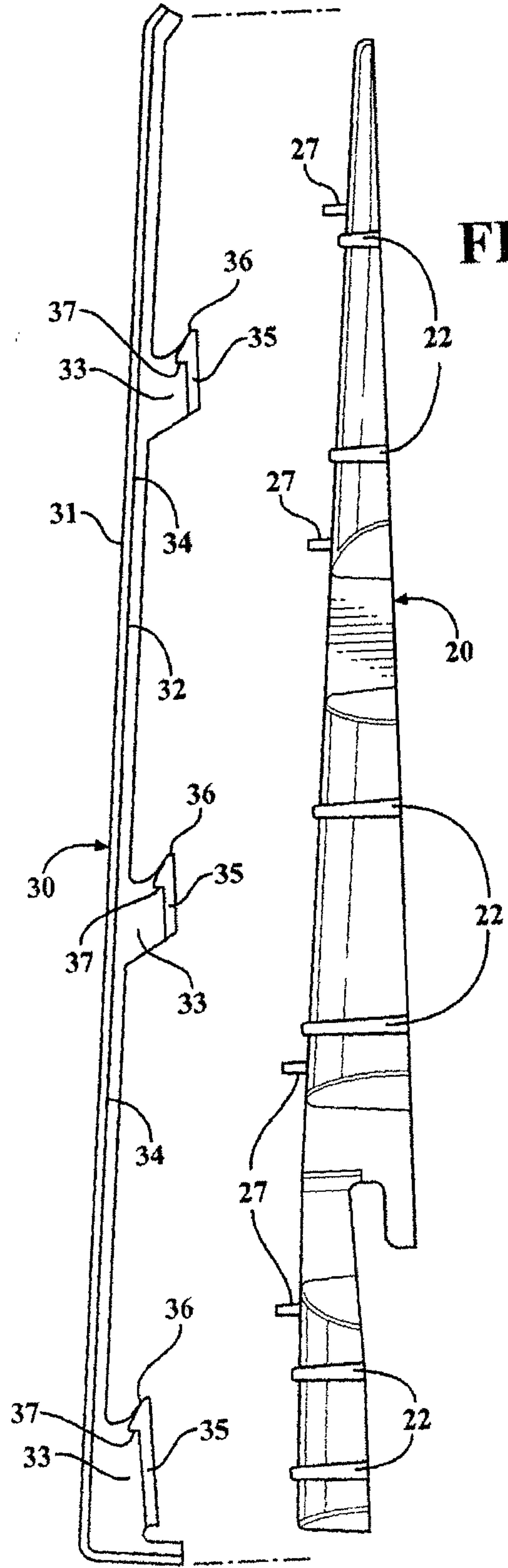


FIG. 5

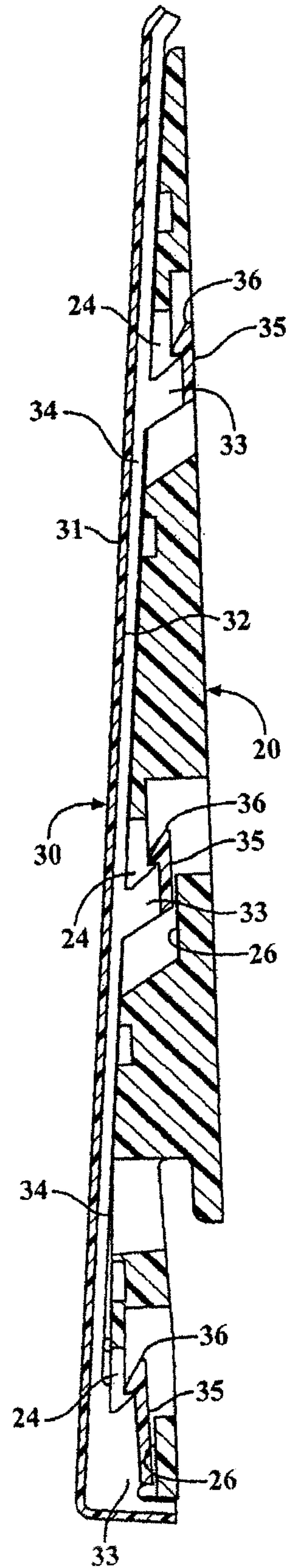


FIG. 6

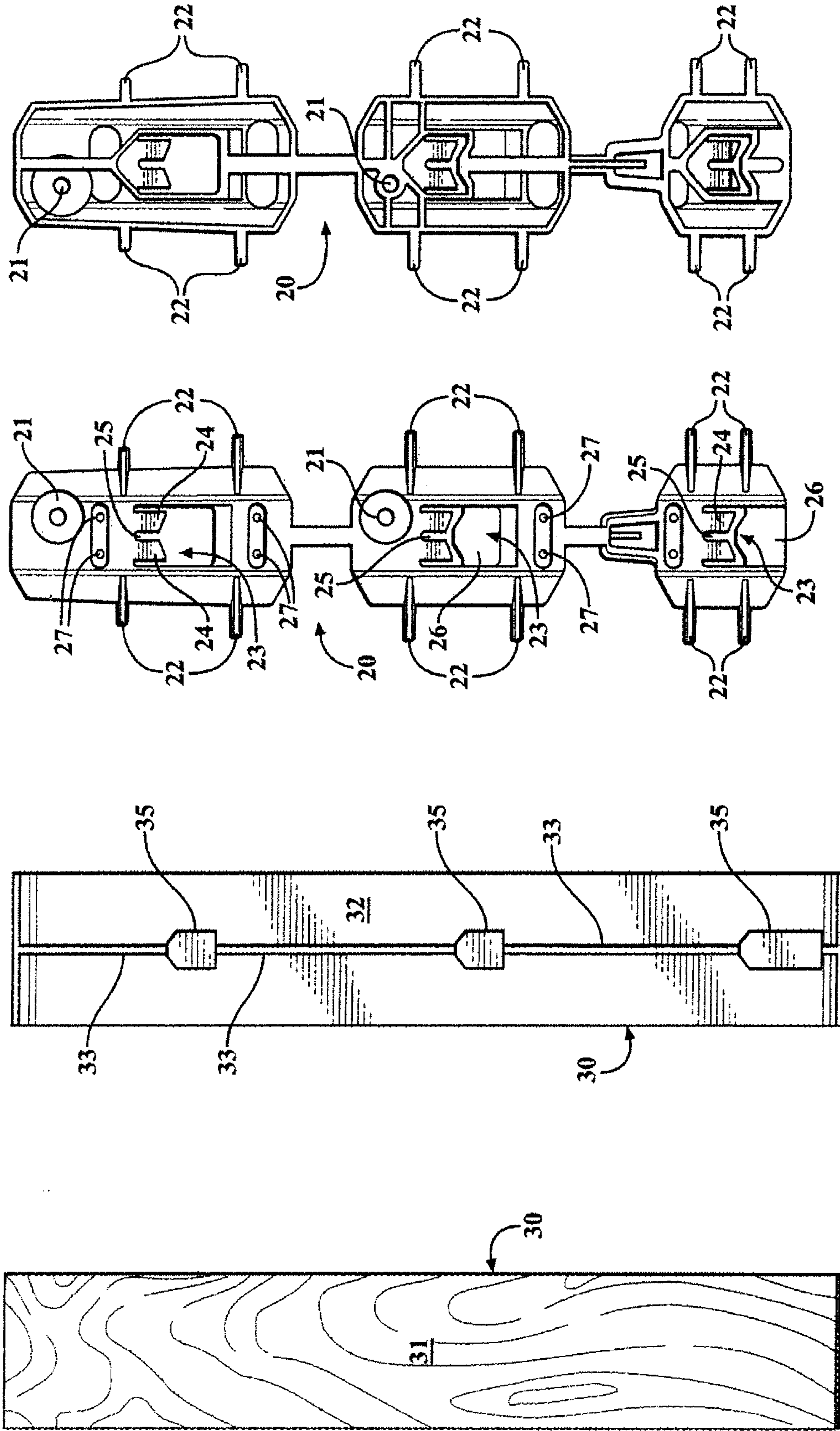


FIG. 7

FIG. 8

FIG. 9

FIG. 10

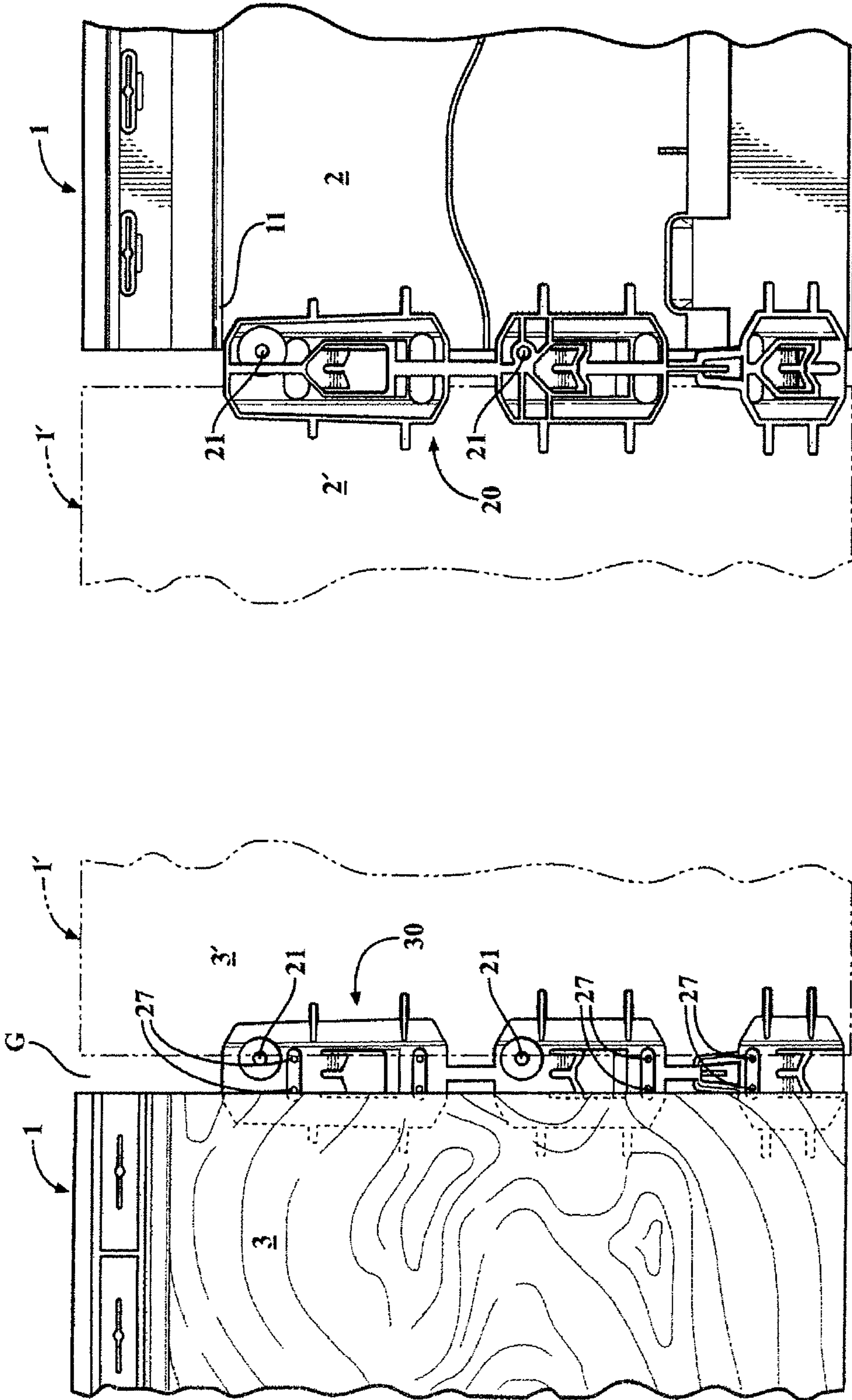


FIG. 12

FIG. 11

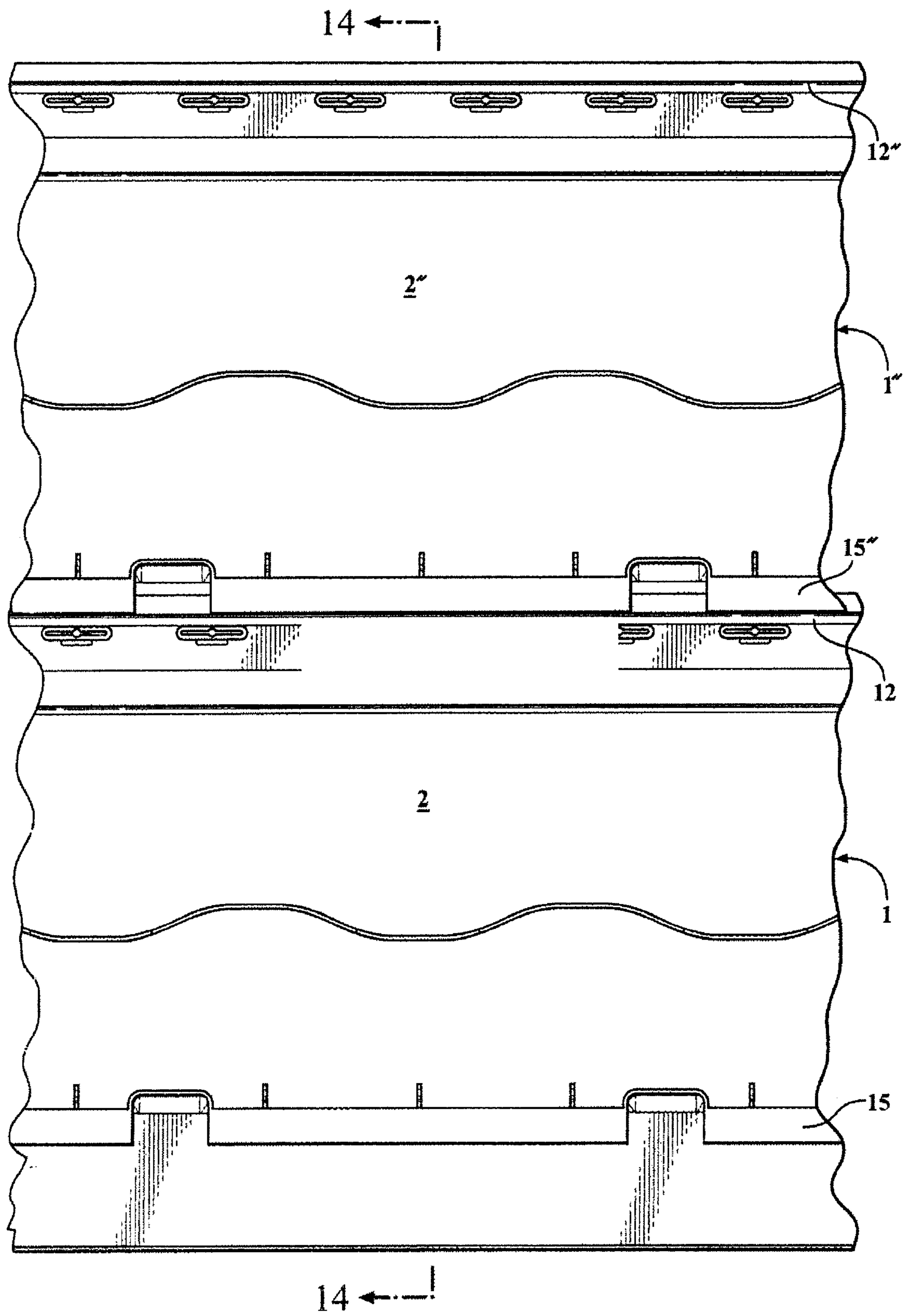


FIG. 13

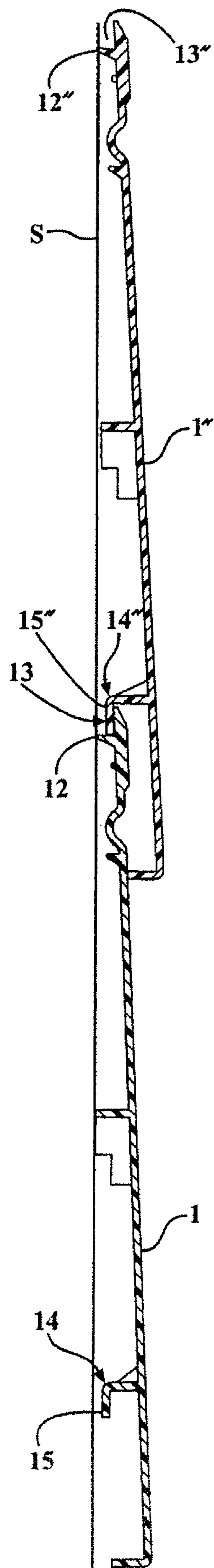


FIG. 14

