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(54) **VENEERS FOR WALLS, RETAINING WALLS  
AND THE LIKE**

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(76) Inventors: **Robert A. MacDonald**, Plymouth, MN  
(US); **William B. Dawson**, Medina,  
MN (US)

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Correspondence Address:

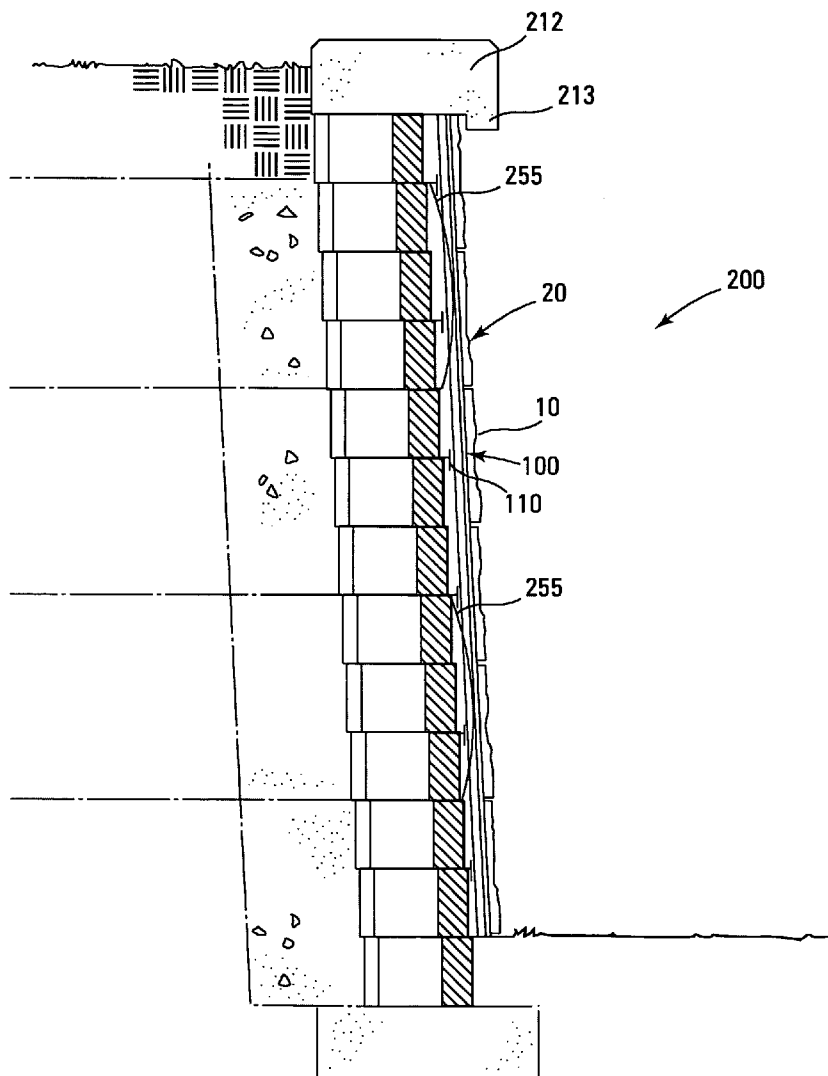
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**SUITE 600**  
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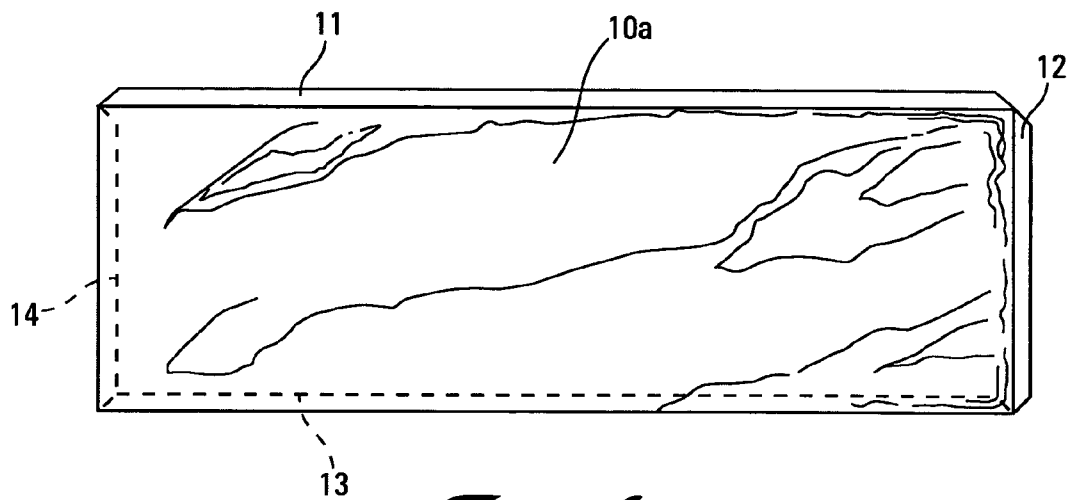
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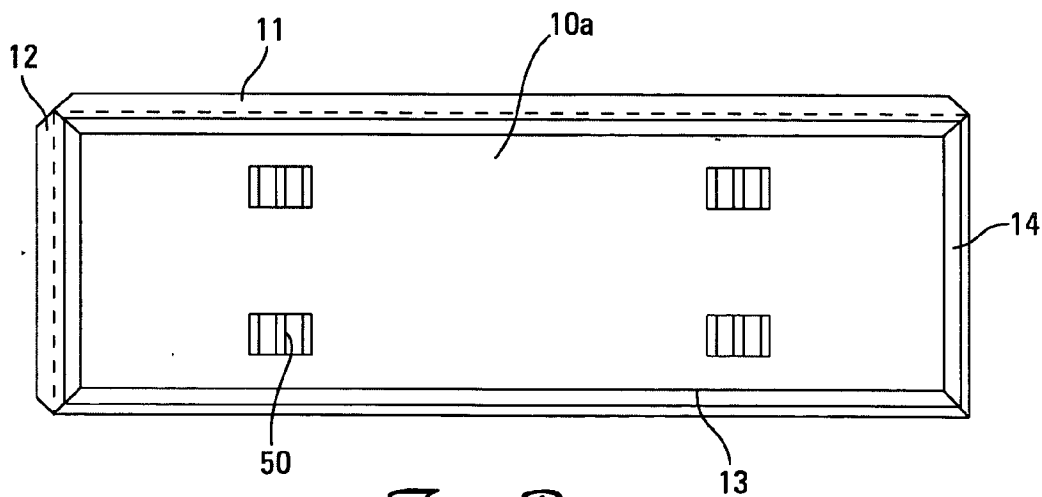
(57) **ABSTRACT**

A veneer panel system is used with a wall or a retaining wall to provide a natural stone appearance and/or to improve the appearance of an existing wall. Panels can be interlocked to form a stable veneer structure. The structure is attached to a wall by various attachment means.

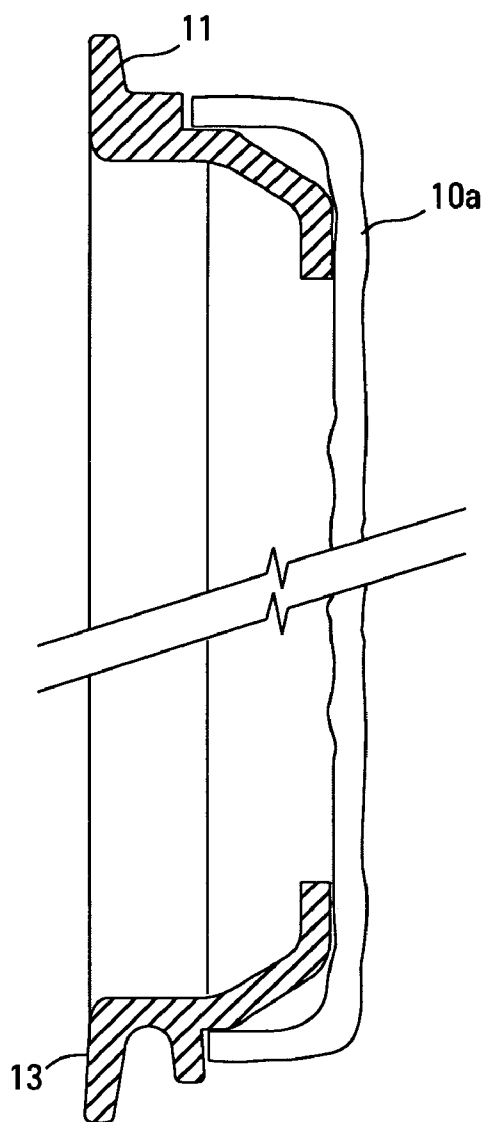




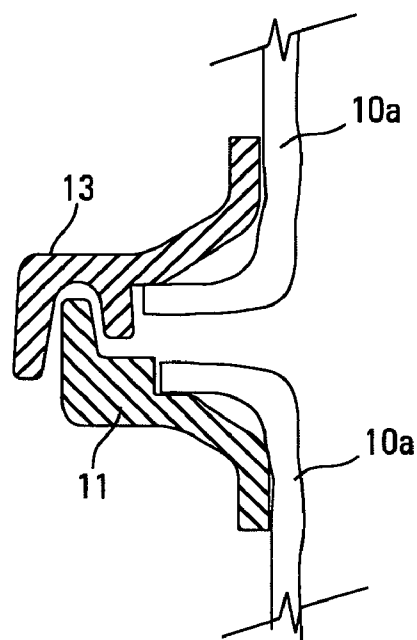
*Fig. 1A*



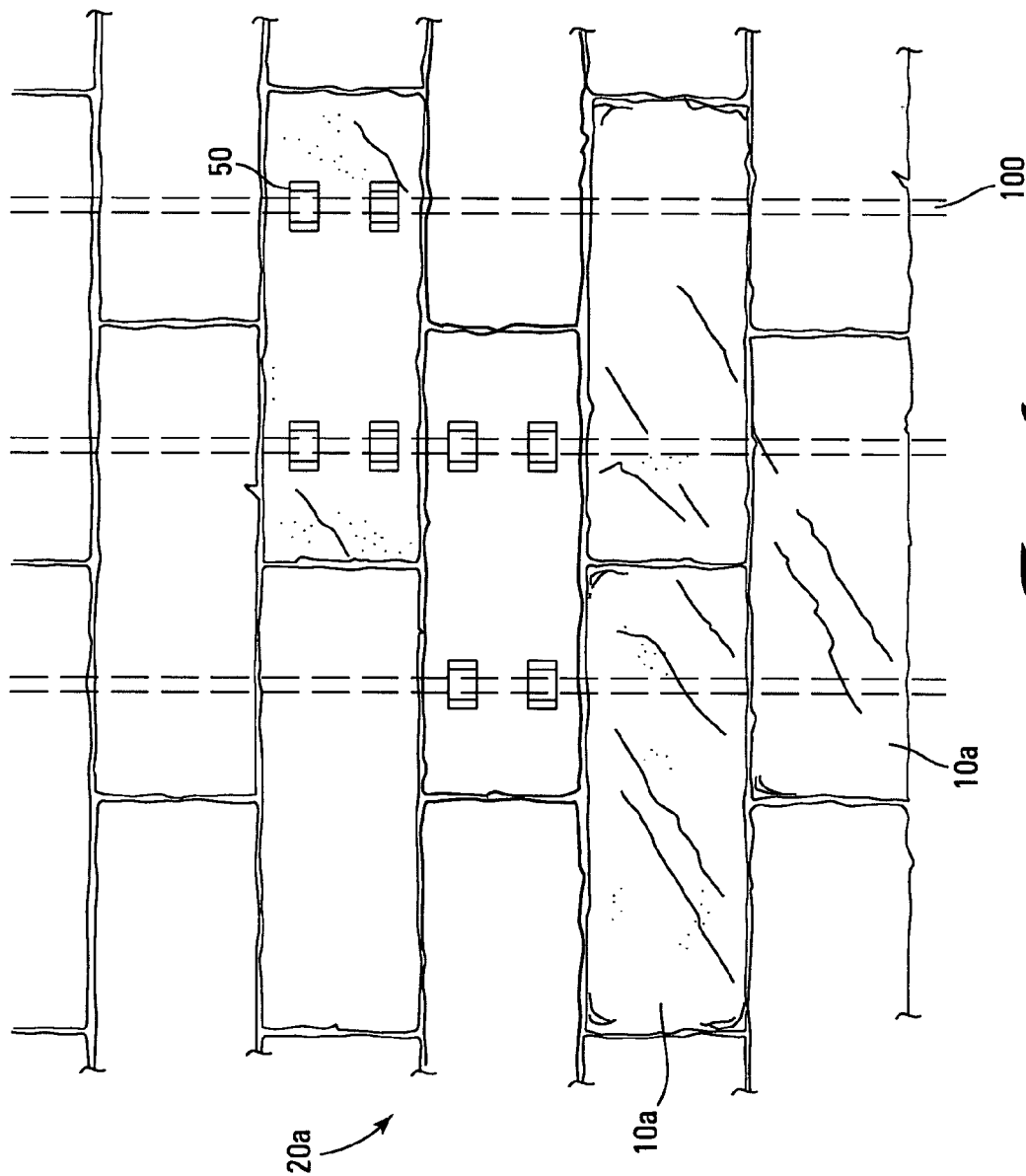
*Fig. 1B*



*Fig. 2A*



*Fig. 2B*



*Fig. 3A*

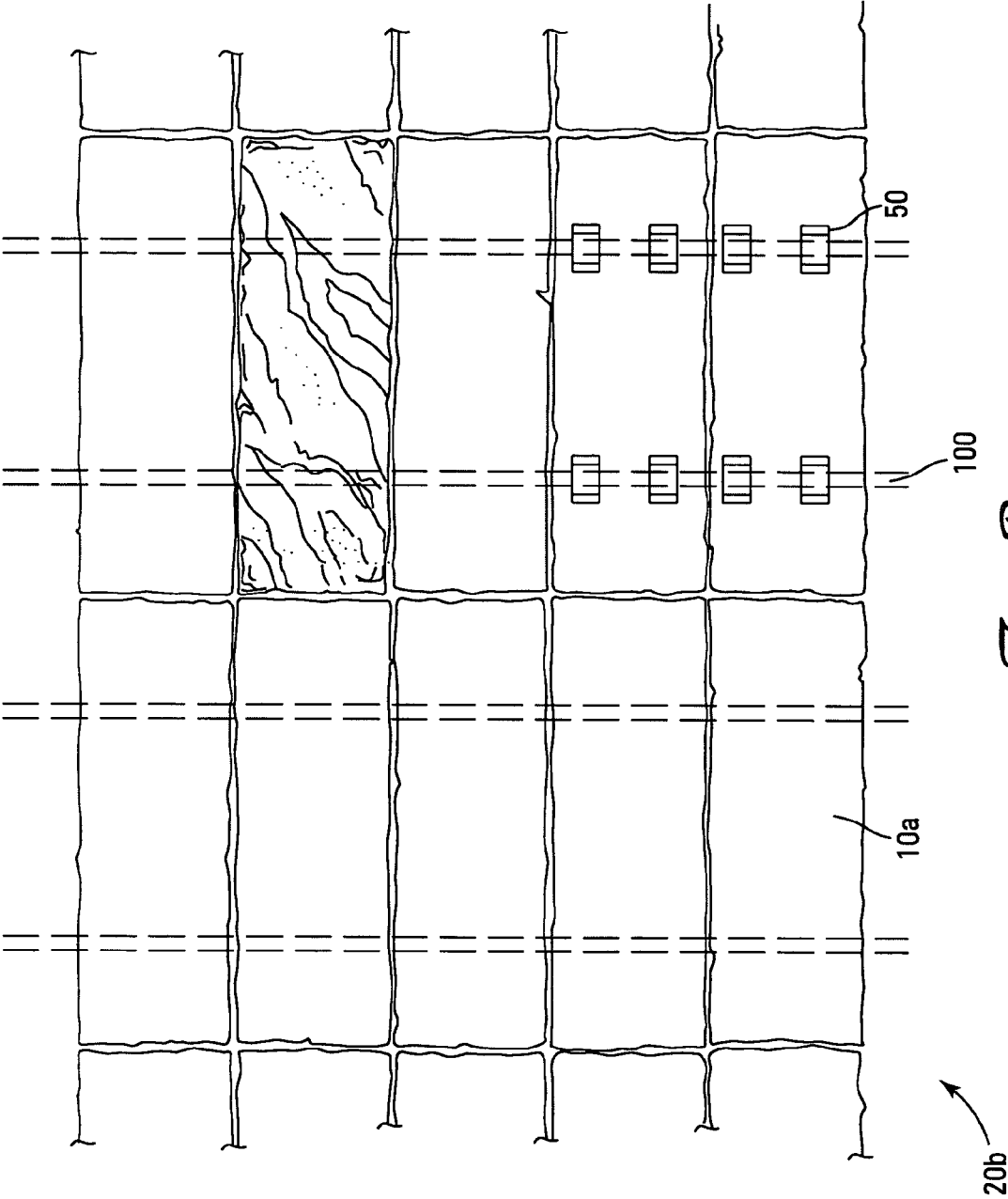
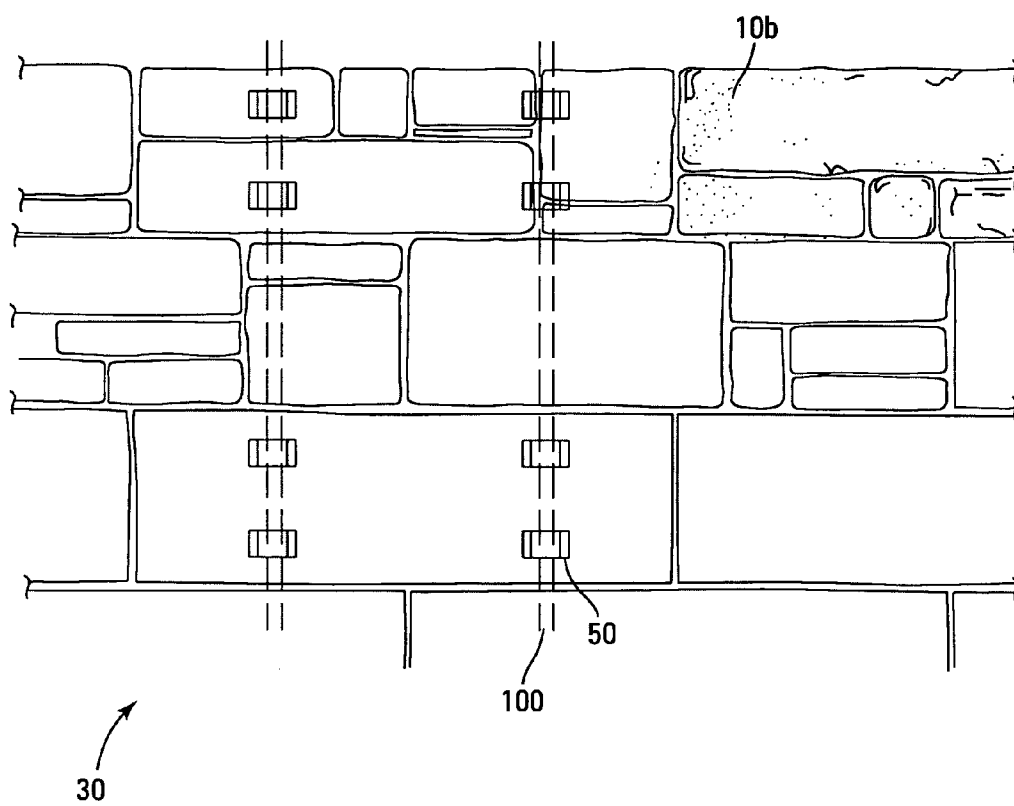
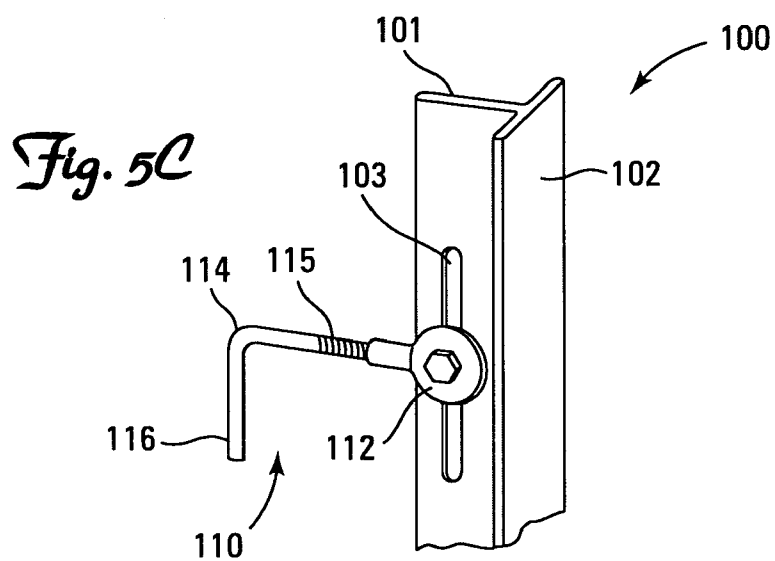
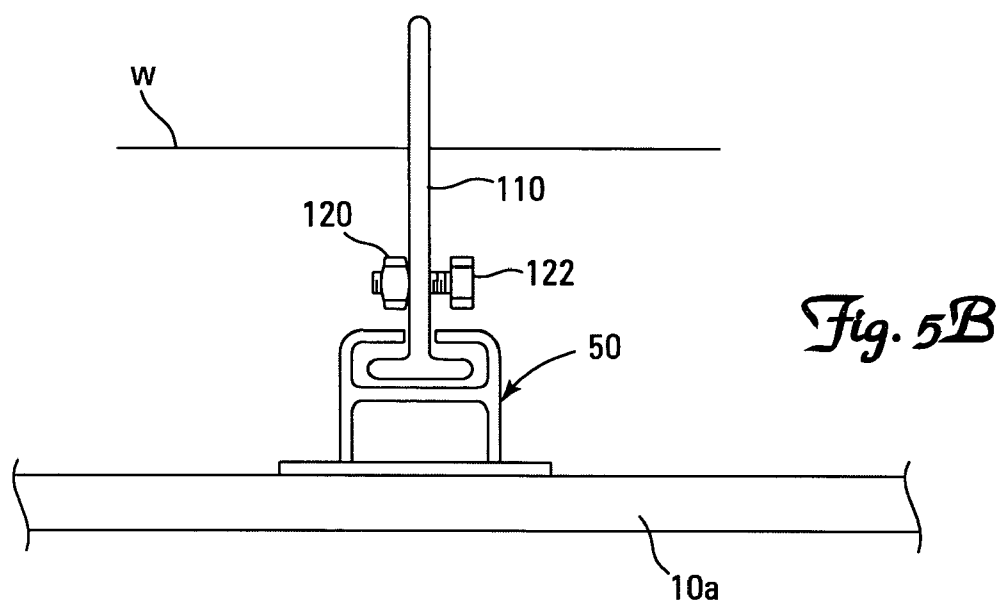
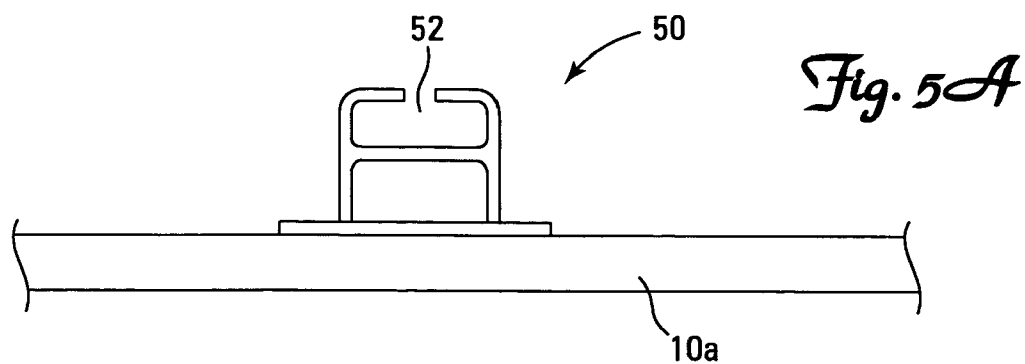
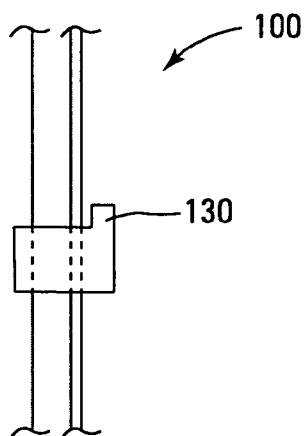


Fig. 3B

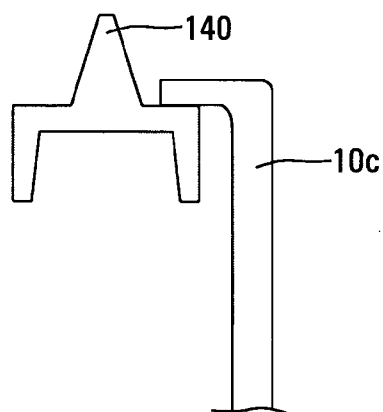


*Fig. 4*

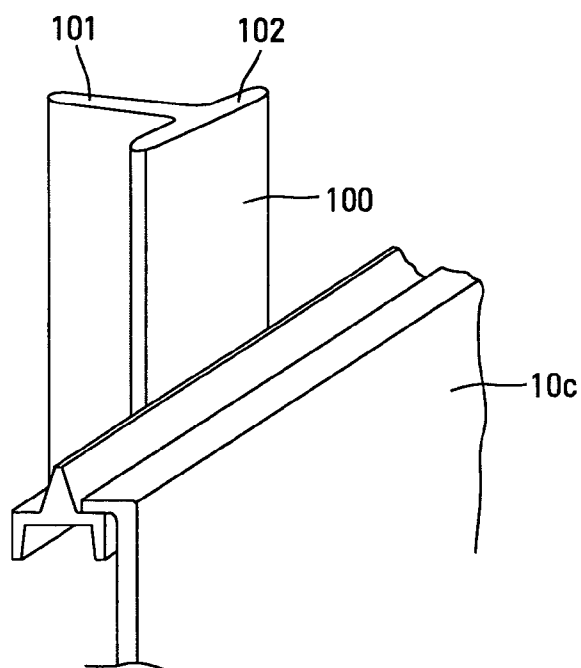




*Fig. 6A*



*Fig. 6B*



*Fig. 6C*



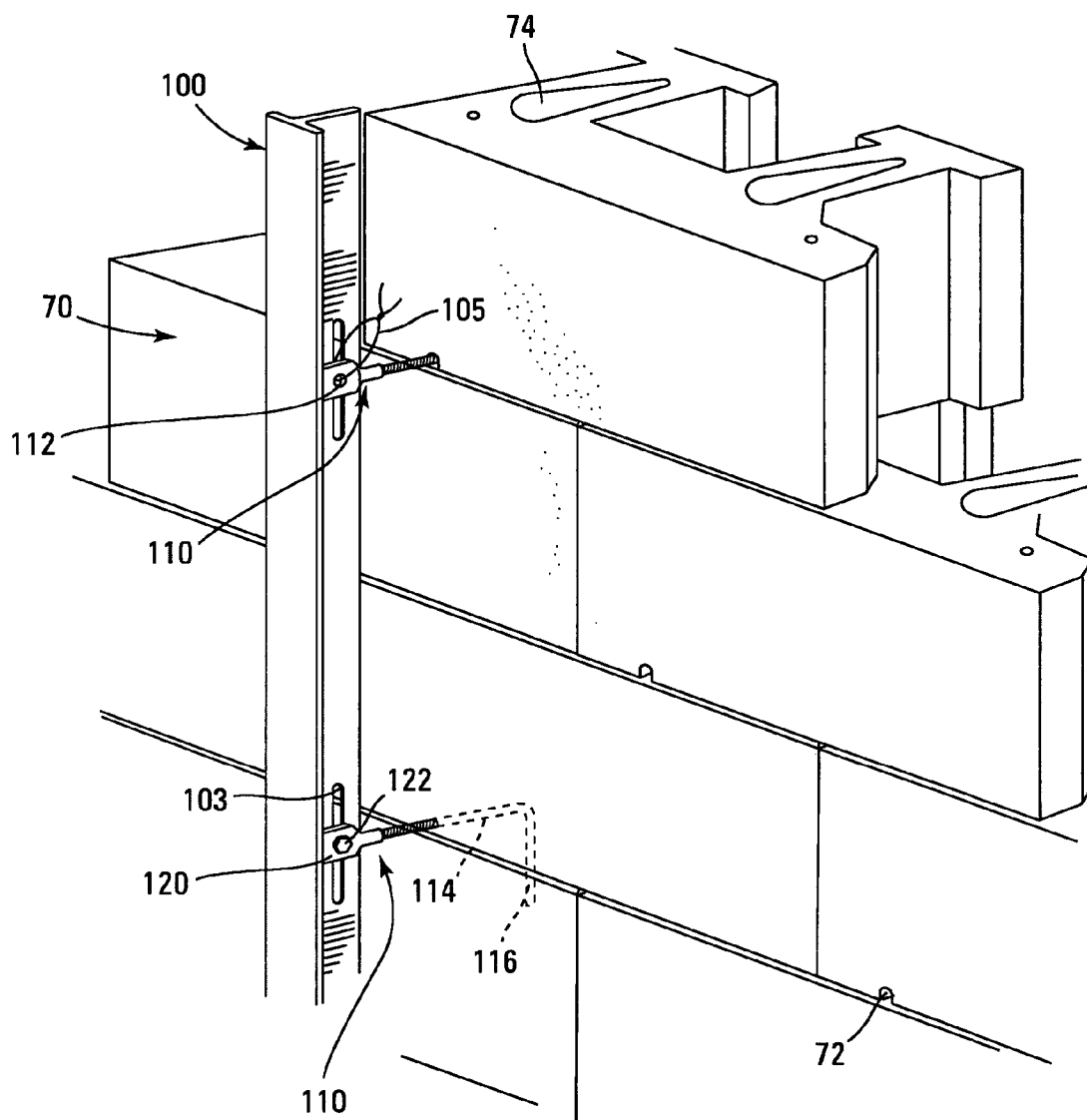


Fig. 7A

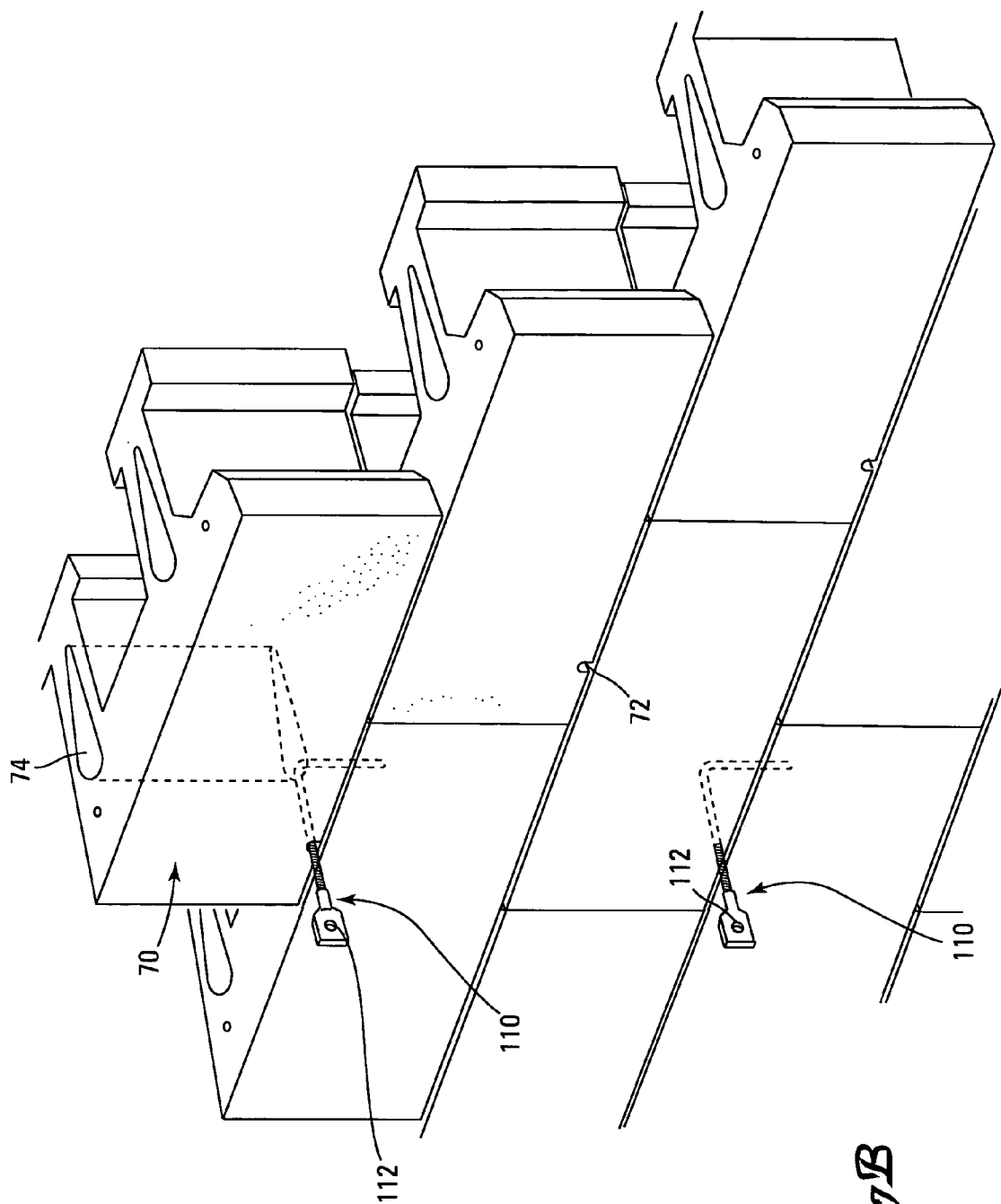
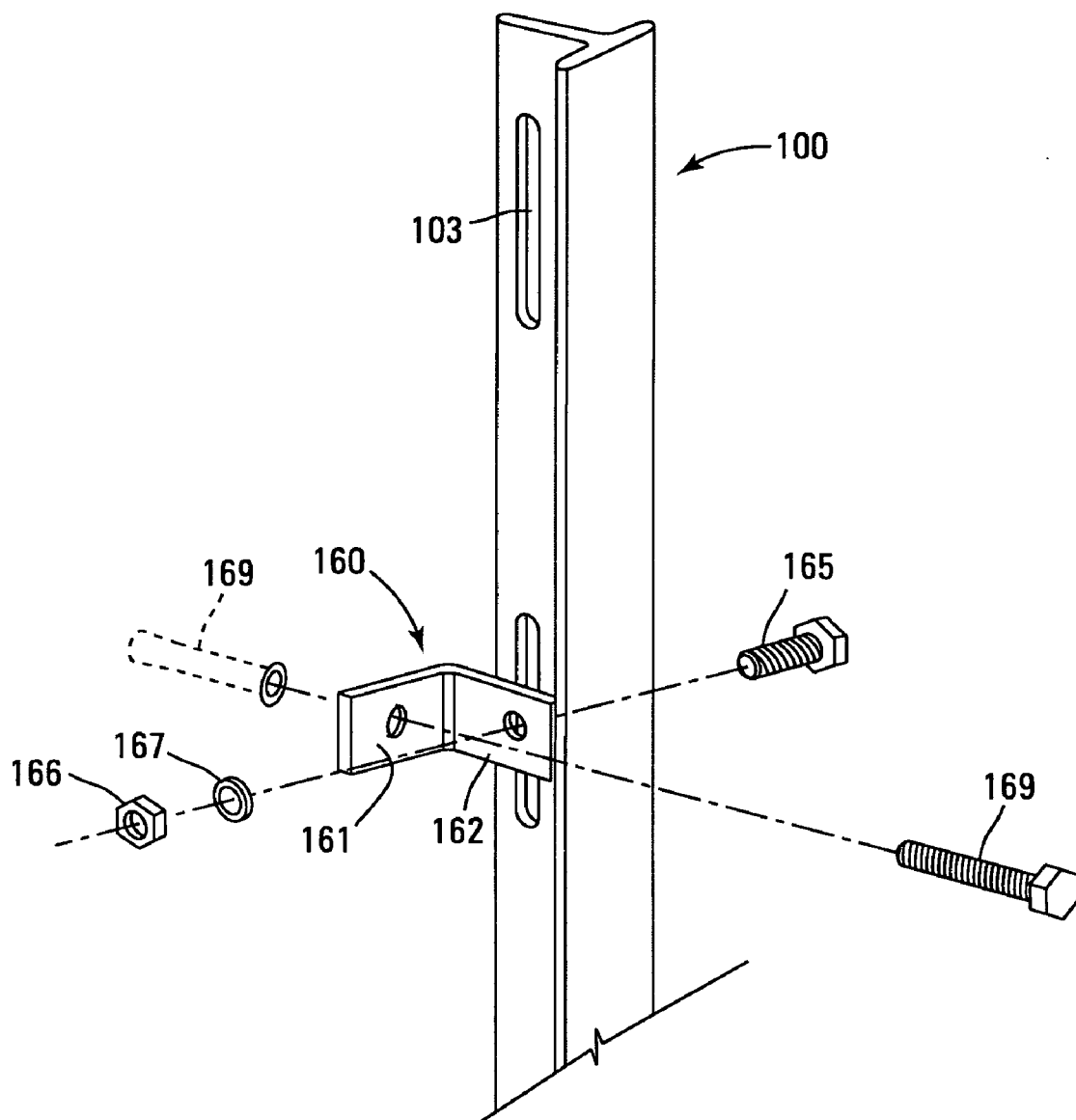
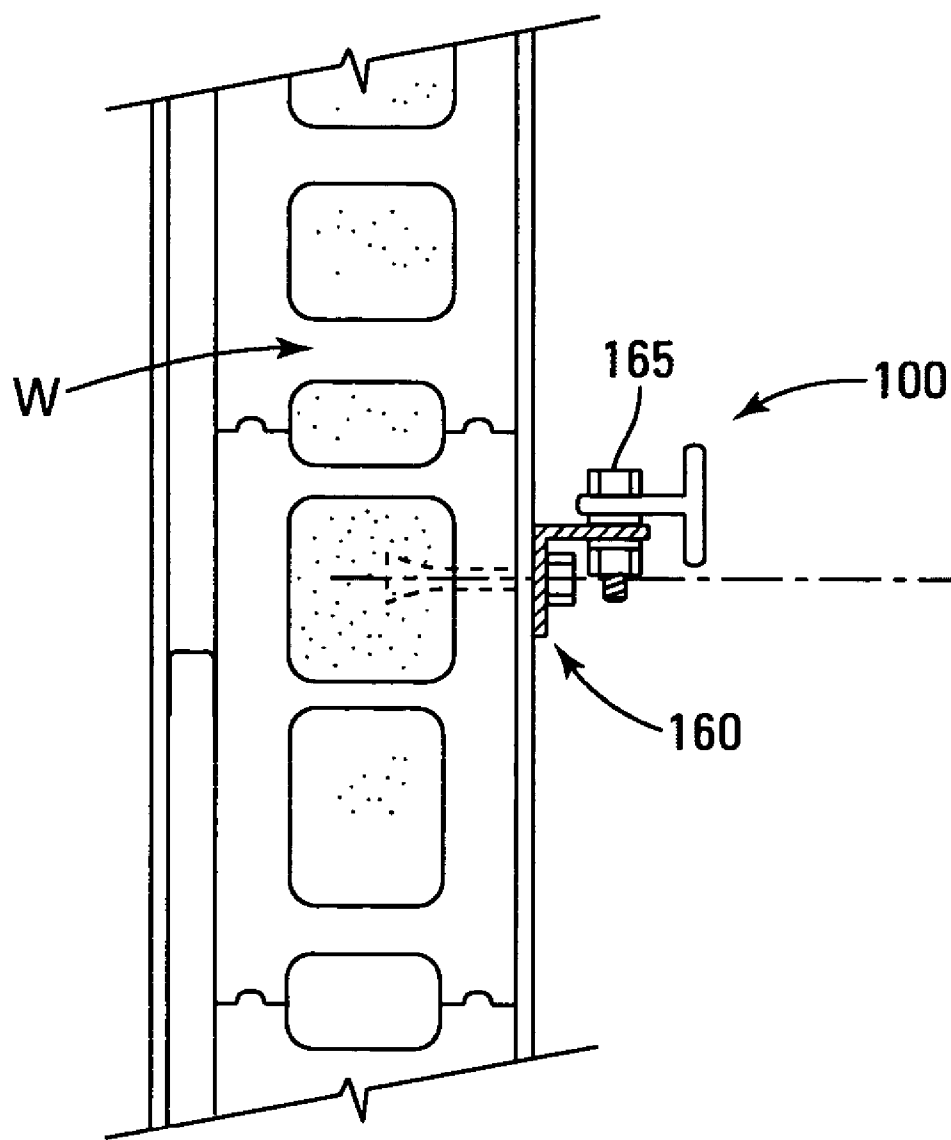


Fig. 7B



*Fig. 8A*



*Fig. 8B*

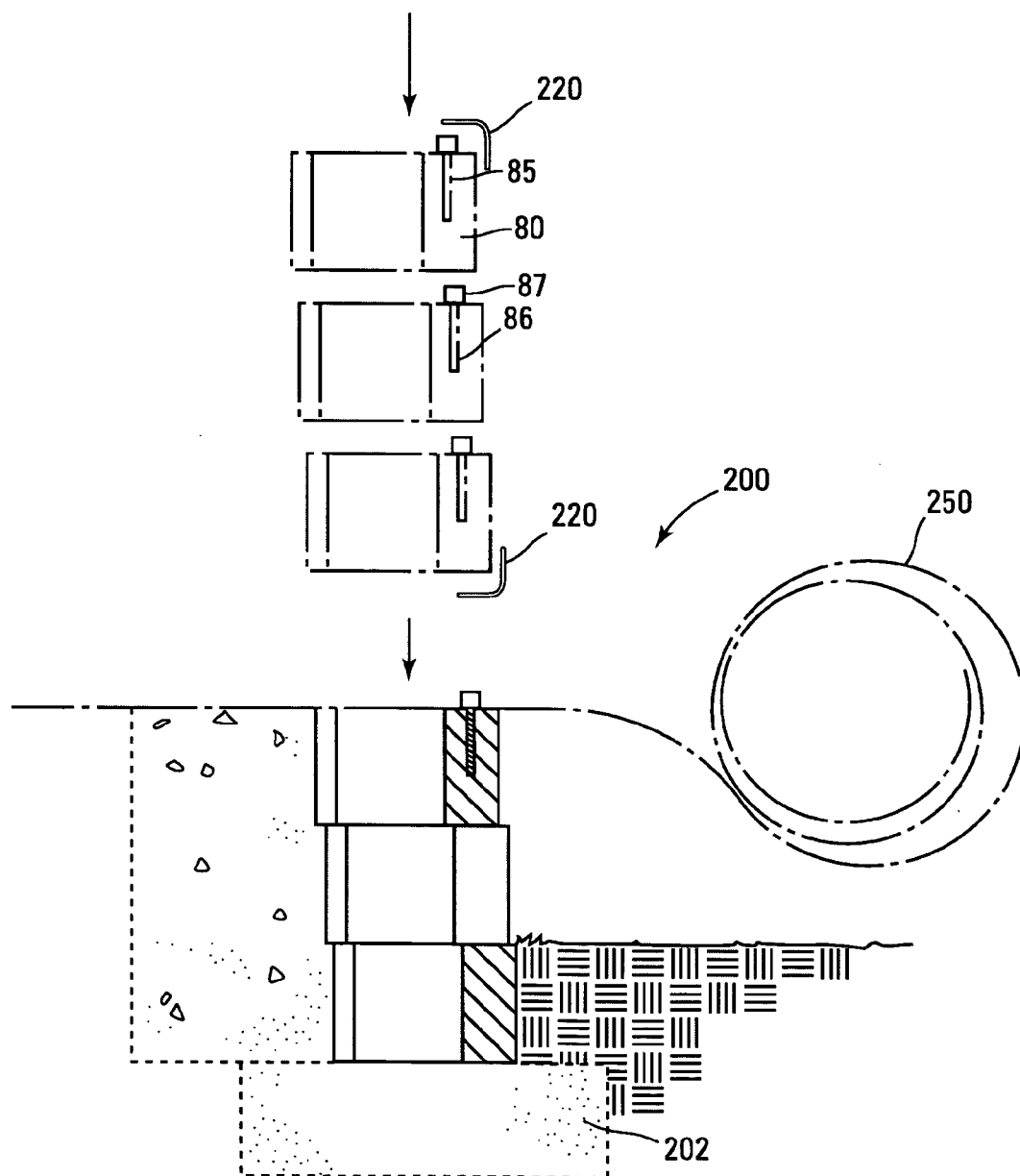


Fig. 9

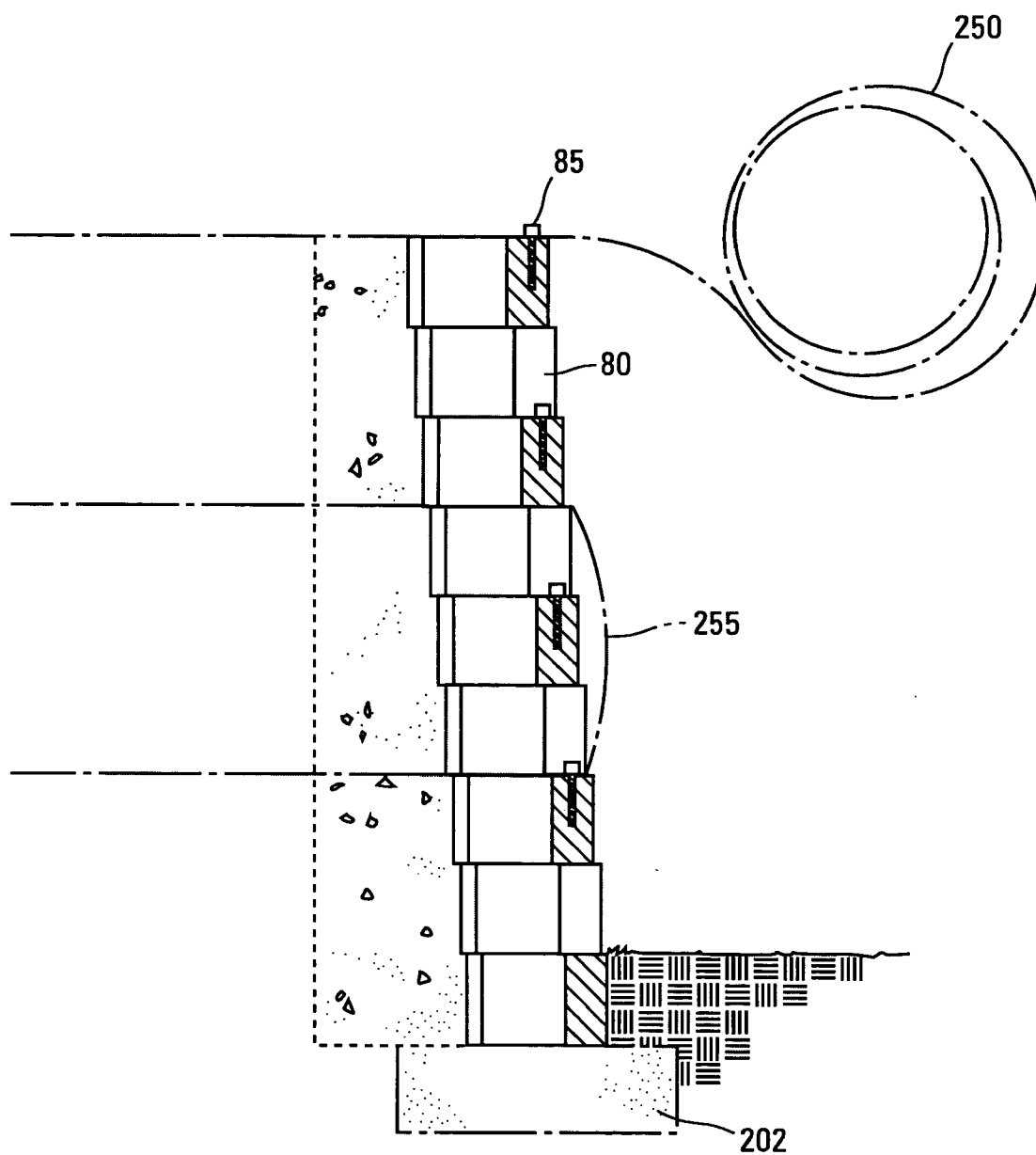


Fig. 10

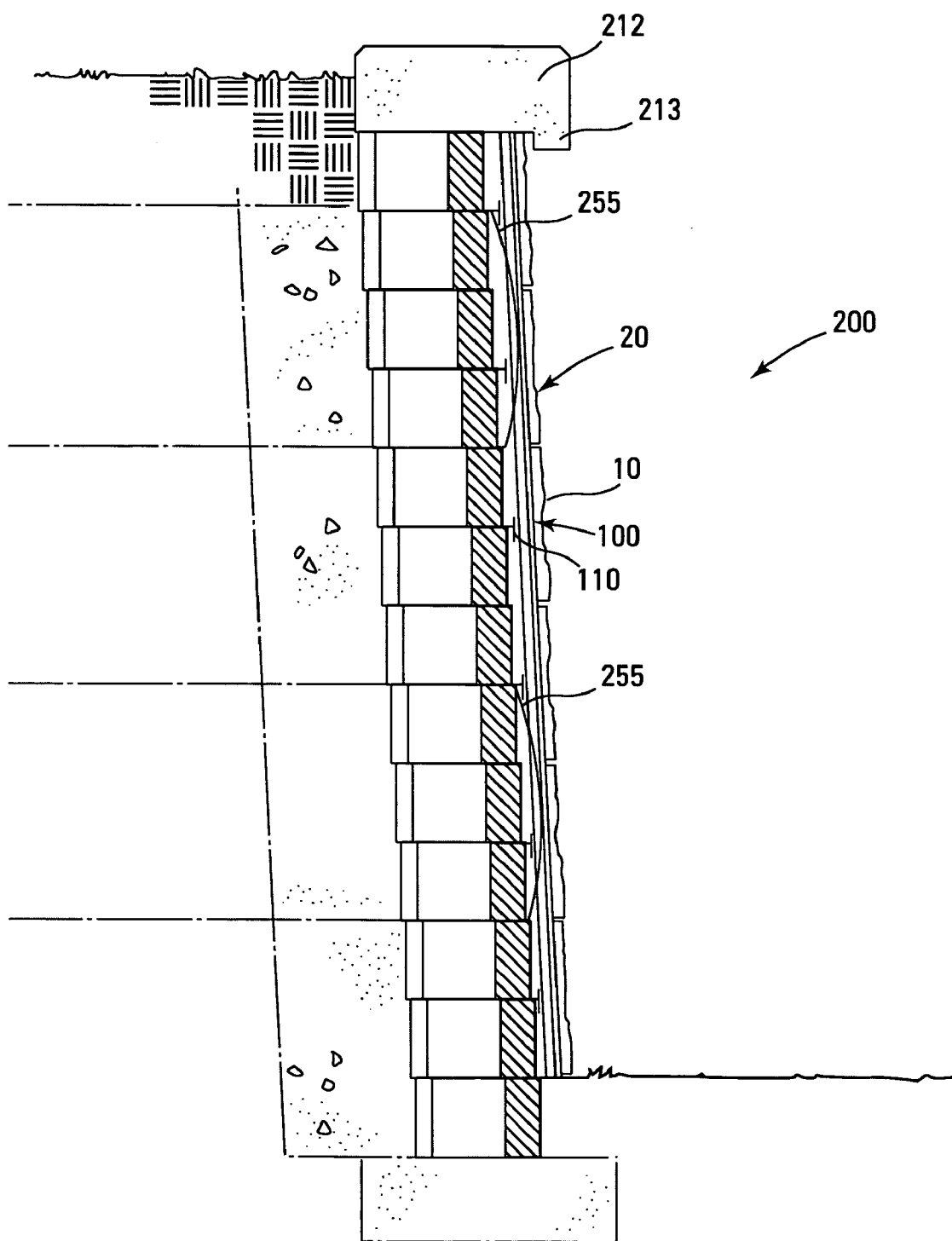
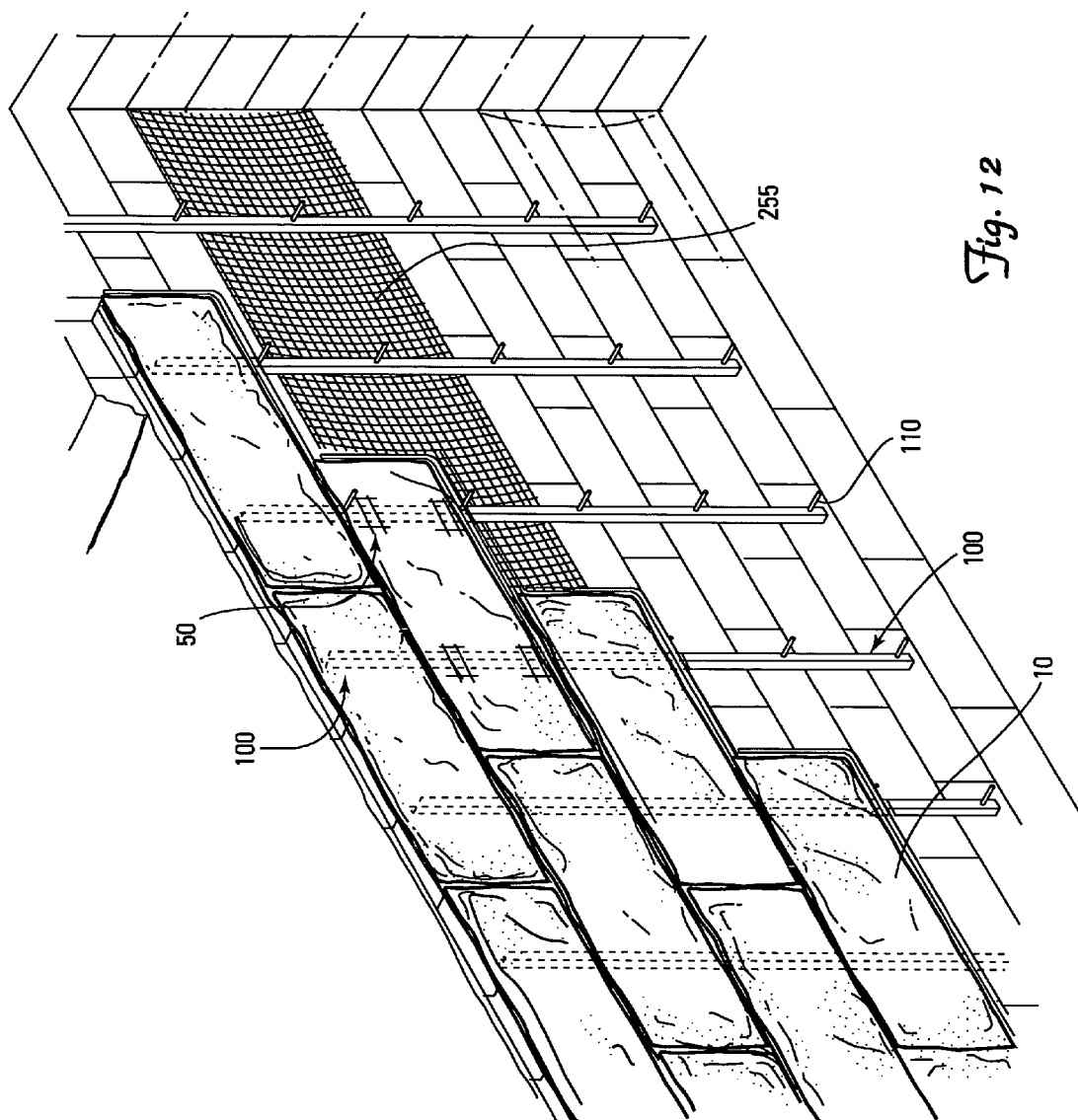
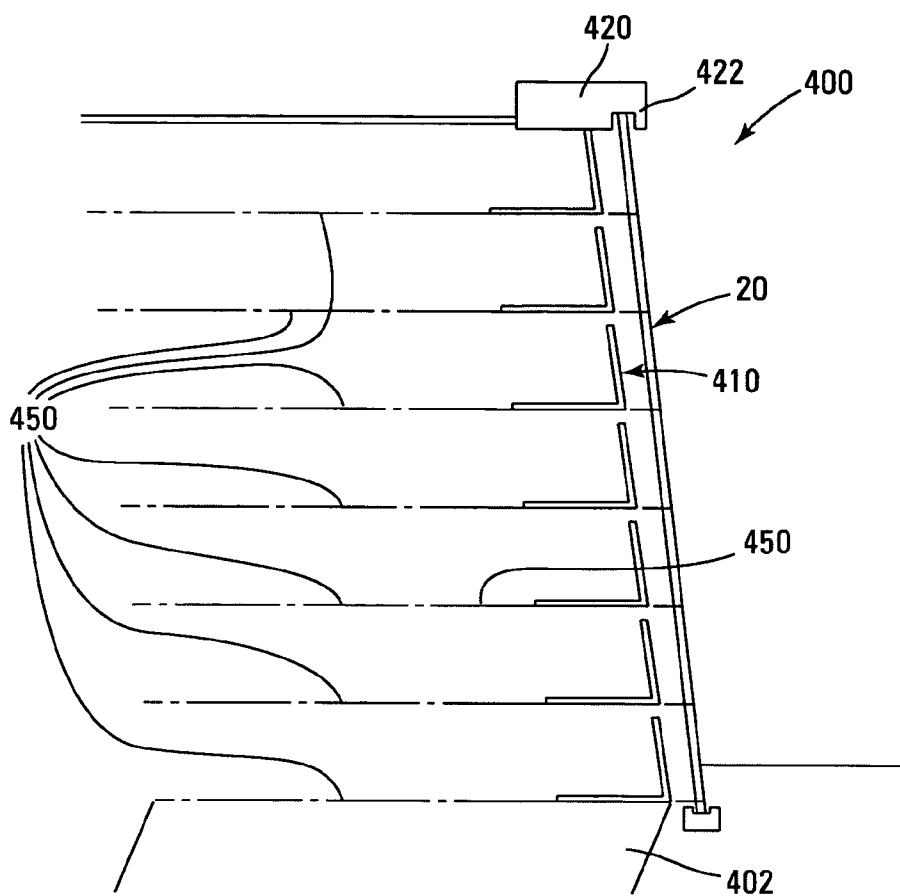


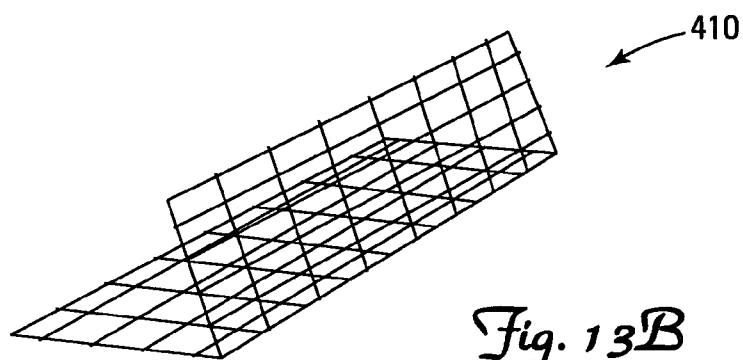
Fig. 11



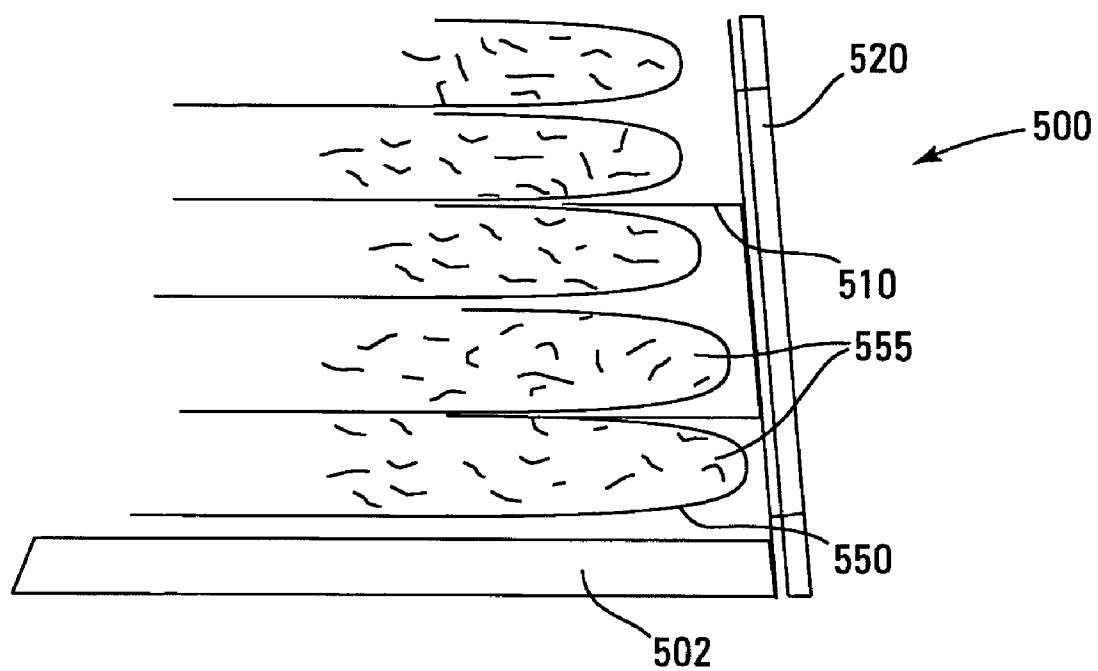




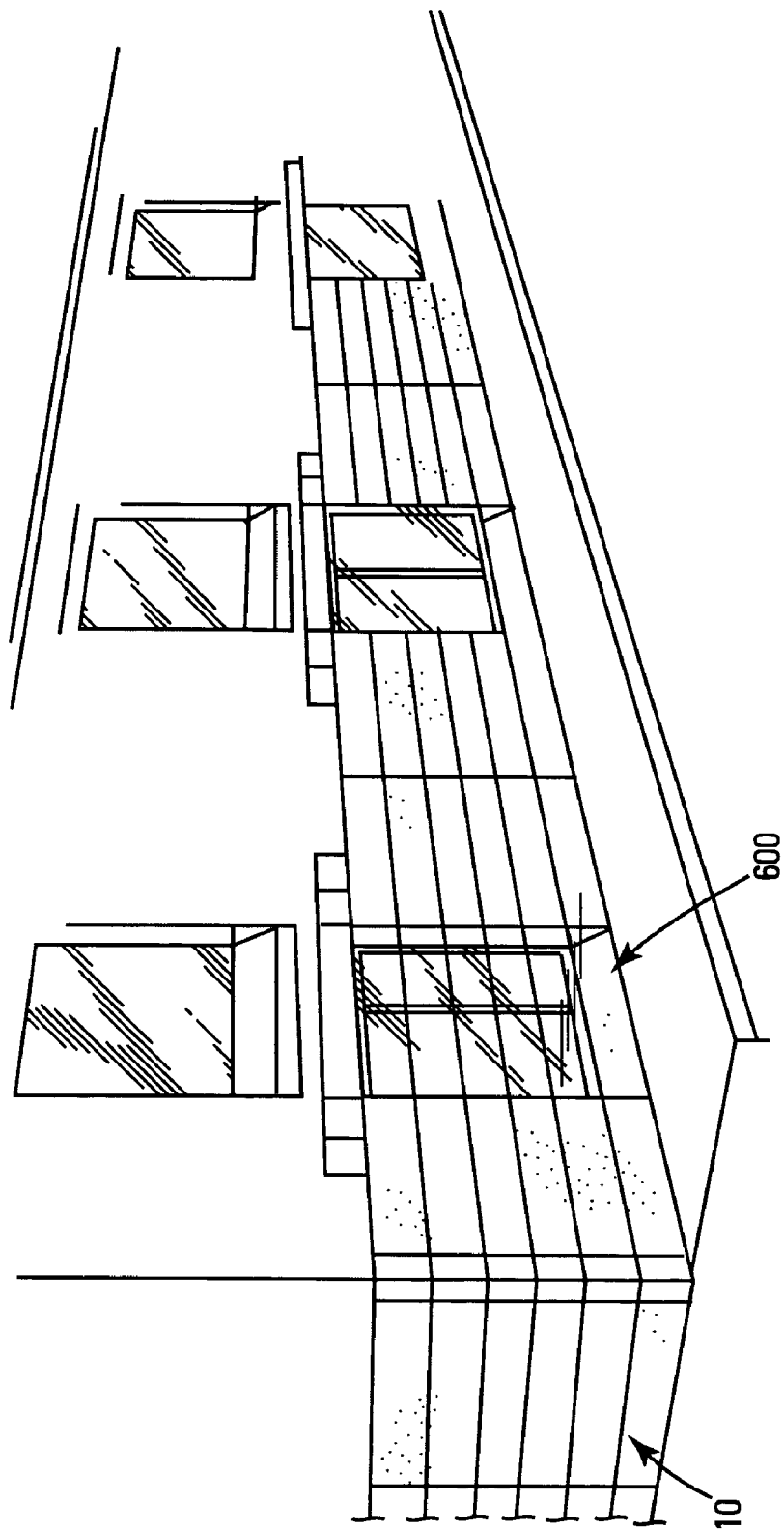
*Fig. 13A*



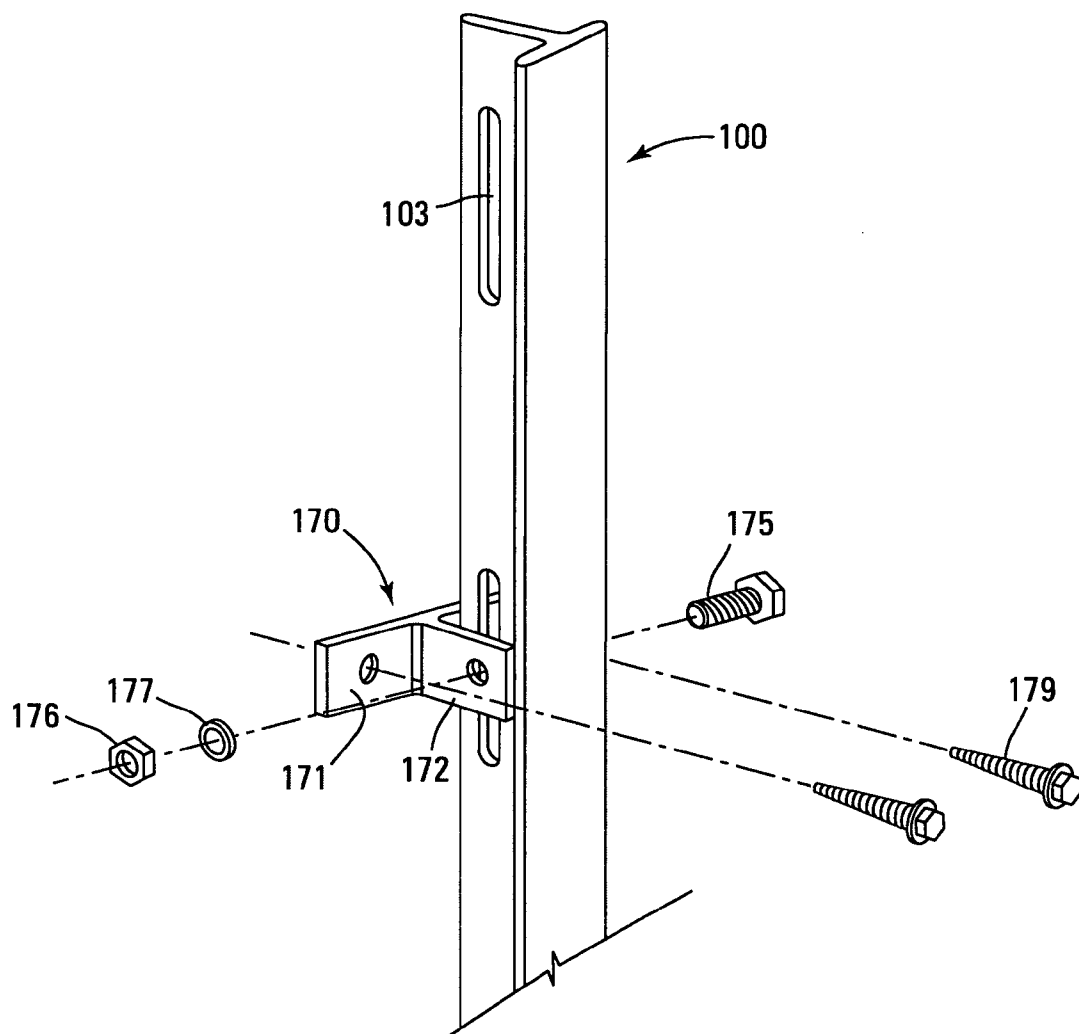
*Fig. 13B*



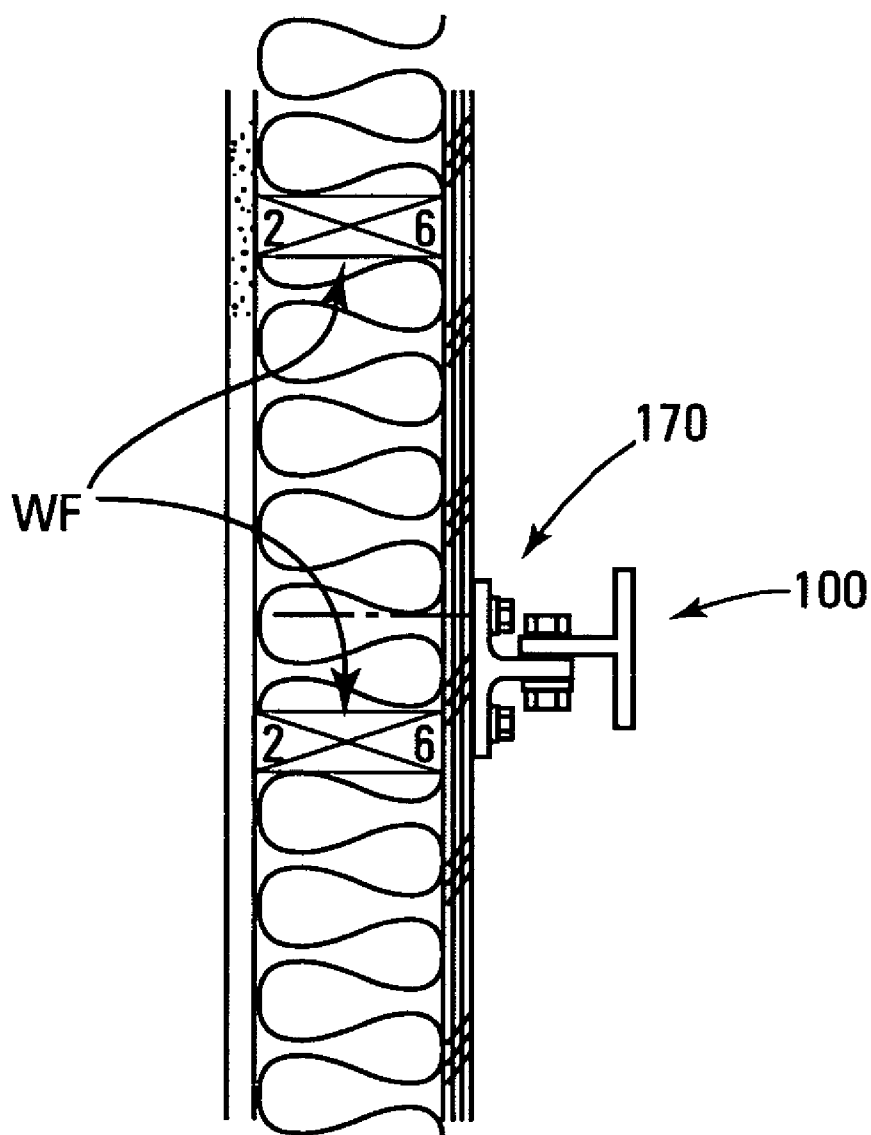
*Fig. 14*



*Fig. 15*



*Fig. 16A*



*Fig. 16B*

## VENEERS FOR WALLS, RETAINING WALLS AND THE LIKE

[0001] This application claims the benefit of provisional application Ser. No. 60/566,616, filed Apr. 29, 2004, the contents of which are hereby incorporated herein by reference.

### FIELD OF THE INVENTION

[0002] This invention relates to walls and retaining walls and in particular relates to a veneer panel system to form a decorative and protective face for such walls either during construction of the wall or after the wall has already been installed.

### BACKGROUND OF THE INVENTION

[0003] Retaining walls are used in various landscaping projects and are available in a wide variety of styles. Numerous methods and materials exist for the construction of retaining walls. Such methods include the use of natural stone, poured concrete, precast panels, masonry, and landscape timbers or railroad ties.

[0004] A widely accepted method of construction of such walls is to dry stack concrete wall units, or blocks. These blocks are popular because they are mass produced and, consequently, relatively inexpensive. They are structurally sound, easy and relatively inexpensive to install. Because they comprise concrete, they are durable. They can be given a desired appearance, such as, for example, natural stone. Many block systems also use pins that are adapted to fit in corresponding pin holes in adjacent blocks or may use other mechanical means to contribute to the stability of a wall.

[0005] Typically, retaining wall blocks are manufactured to have the desired appearance on the front face (i.e., the outer face of a wall) because only the front is visible after the wall is constructed. It is highly desirable to have the front face of the wall system have a natural stone appearance, and many approaches are used in the art to treat or process concrete to evoke the appearance of natural stone, including splitting the block, tumbling the block to weather the face and edges of the face, and using processing or texturing equipment to impart a weathered look to the concrete.

[0006] Depending upon their location, the soil type, the amount of water that can flow through the wall, and the mineral content of the water, an undesirable appearance can develop on the surface of a retaining wall. In addition, due to exposure to the elements and freeze/thaw cycles, concrete retaining walls may exhibit spalling, that is, chipping and cracking of concrete, which affects their appearance and can ultimately affect their utility. Freeze-thaw effects are worsened when the wall face is exposed to salt spray, which commonly occurs on roadways where de-icing salts are used to clear the road of ice and snow. Efflorescence refers to the leaching of mineral salts from water and this often occurs on walls in contact with water. The resultant deposit on a surface creates an unattractive white stained appearance on a wall.

[0007] There have been prior efforts to veneer segmental retaining walls with natural stone or concrete that is molded to closely resemble natural stone. While such veneering produces aesthetically pleasing walls, it is a laborious and highly expensive process, as it requires skilled masonry

work to tie in the stone or concrete veneer to the wall using traditional mortared masonry construction methods. Such veneering can double the cost of the finished wall. In addition, segmental retaining walls are not rigid structures and applying a rigid mortared veneer may cause cracking unless appropriate steps are taken to provide slip joints.

[0008] Accordingly, it would be desirable to provide a retaining wall system that would be easy to install, that would possess an appearance that closely resembles natural stone and that would keep its desirable appearance indefinitely. Another need in the art is a way to improve the appearance of surface-damaged or stained retaining walls.

[0009] Many retaining wall systems described in the art include the use of reinforcing materials, also referred to as geogrids, geosynthetic reinforcement, or geogrid soil reinforcement. These terms sometimes are used interchangeably, and "geogrid" as used herein is intended as a generic term. Reinforcement materials may be inextensible, such as steel mesh, or extensible geosynthetic materials, such as mats and oriented polymeric materials. For example, flat polymeric sheets are used to form geogrids by forming holes in the sheets and then drawing them to orient the polymer and increase the modulus. Such polymeric materials include high density polyethylene (HDPE) and these materials form relatively stiff geogrids commercially available under the trade designation "TENSAR".

[0010] While the HDPE materials are relatively stiff, a second type of geosynthetic material is composed of a mat typically formed from polyester fibers that are woven or knitted. These may comprise rectilinear polymer constructions characterized by large (e.g., 1 inch (2.5 cm) or greater) openings. In these open structure geogrids, polymeric strands are woven, knitted or "welded" (by means of adhesives and/or heat) together in a grid. Polymers used for making relatively flexible geogrids include polyester fibers. The polyester typically is coated, commonly using a polyvinyl chloride (PVC) or a latex topcoat. The coating may contain carbon black for ultraviolet (UV) stabilization. Some open structure geogrids comprise polyester yarn for the warp fibers and polypropylene as the fill fibers.

[0011] Another flexible reinforcing geosynthetic material is fabric, i.e., woven or non-woven constructions without large openings. These fabrics typically comprise polymers and may be referred to as geofabrics. The geofabric can be laid between courses of blocks in a wall, and typically is tied into the wall and held there. When blocks are configured to have pin connectors, for example, a hole or slit is formed in the geofabric at the construction site and the geofabric is held on the blocks by fitting it over the pins.

[0012] In common use, the geogrid extends behind the retaining wall and ties into the earth behind the wall, thus creating a cohesive soil mass tied into the wall facing that resists overturning. Geogrids are either mechanically connected to a course of blocks or rely on the friction created by placing the geogrids layer between courses of blocks. When the mode of connection is friction alone, the geogrid is placed on top of a course of blocks, and then a succeeding layer of blocks is placed on top of the geogrid. When the connection is mechanical, after placement of a course of blocks to the desired height, geogrid is placed onto a course of blocks and held in place by means of pins in the block (which may have a primary function of aligning and holding

blocks together) or by means of special connectors. Flexible geogrid is put under tension by pulling back and staking the geogrid behind the retaining wall. Backfill is placed and compacted over the geogrid. Construction of the wall continues and may include additional layers of geogrid.

[0013] Such systems have proven reliable in many wall applications. There are limits to their performance however, particularly at the upper portions of the wall, where the load of the blocks above the geogrids layer do not provide as much load on the connection, so that frictional forces are reduced. The use of frictional connections forces the wall designer and builder to use more and higher strength geogrids because connection strength limits the strength of the system, and this adds expense to the wall. Mechanical connectors attempt to overcome this limitation by mechanically connecting the geogrids to the wall facing in a way that is not load dependent. The difficulty with this approach is that in order for such connectors to provide high levels of efficient connection they must add considerable expense to cost of using the geogrids reinforcement, and add complexity and expense to the installation process. Thus there are shortcomings to both approaches.

[0014] There are also many wall applications in seismic zones where providing an extra measure of protection against loss of connection between the wall facing and the reinforcing geogrids during a seismic event would be highly desirable. Thus there is a need for a geogrid connection system that is not load dependent, that does not add significant expense to the construction of the wall, and that is highly reliable and resistant to failure during seismic conditions.

#### SUMMARY OF THE INVENTION

[0015] We have invented a veneer panel system that can be used with a wall or a retaining wall to provide a variety of desired appearances, including an appearance that closely resembles a variety of natural stone types and to improve the appearance of the front face of an existing wall. Individual panels form a veneer for the wall; the panels preferably are interlocked to form a stable veneer structure. This structure is attached to a wall by various attachment means. This system also permits a cost effective maximum positive connection of geogrid with blocks or units comprising the retaining wall while providing the desired appearance.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0016] FIG. 1A is a front view of a panel of this invention and FIG. 1B is a back view of a panel of this invention.

[0017] FIG. 2A is a side view of a panel of this invention with tongue and groove connectors and FIG. 2B is a partial side view of two panels showing the detail of the tongue and groove connection.

[0018] FIG. 3A is a front view of a portion of a veneer panel system having a running bond pattern and FIG. 3B is a view of a portion of a veneer panel system having a stacked bond pattern.

[0019] FIG. 4 is a front view of a portion of a veneer panel system wherein panels have various patterns.

[0020] FIG. 5A is a top view of an adaptor of this invention; FIG. 5B is a top view of the adaptor interlocked with a rail; and FIG. 5C is a partial perspective view of a rail and its attachment.

[0021] FIG. 6A is a side view of a hanging bracket, FIG. 6B is a side view of hanging element, and FIG. 6C is a perspective view of a panel hung from a rail.

[0022] FIG. 7A is a partial perspective view of a rail attached to a wall and FIG. 7B is a partial perspective view showing the bracket attachment to a wall.

[0023] FIG. 8A is a perspective view of a rail showing attachment by an L-bracket and FIG. 8B is a top view of a portion of a wall having a rail attached by an L-bracket.

[0024] FIG. 9 is a sectional view of a retaining wall block system showing the placement of one layer of geogrid.

[0025] FIG. 10 is a sectional view of a retaining wall block system with geogrid wrapped around three courses of blocks.

[0026] FIG. 11 is a sectional view of a completed retaining wall having two geogrid wraps.

[0027] FIG. 12 is a partial perspective view of a veneer panel system of this invention with one geogrid wrap.

[0028] FIG. 13A is a sectional view of a wire basket retaining wall with geogrid and FIG. 13B is a perspective view of a wire basket.

[0029] FIG. 14 is a partial sectional view of a retaining wall with a veneer panel system of this invention with multiple geogrid wraps.

[0030] FIG. 15 is a perspective view of a building wall with the veneer panel system of this invention.

[0031] FIG. 16A is a perspective view of a rail showing attachment by an angle bracket and FIG. 16B is a top view of a portion of a wall having a rail attached by an angle bracket.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] In this application, wall refers to structures comprising natural stone, poured concrete, precast panels, masonry, landscape timbers or railroad ties, and retaining wall blocks. Panels having a desired appearance are used as a veneer by attaching the panels to the exposed surfaces of a wall.

[0033] In a preferred embodiment, the panels of this invention are used with retaining walls, and in a most preferred embodiment, the retaining walls comprise blocks. The blocks are made of a rugged, weather resistant material, preferably (and typically) zero-slump molded concrete. Other suitable materials include plastic, reinforced fibers, wood, metal and stone. The blocks may have various shapes and characteristics, as known in the art, and may be stacked one upon the other to provide a straight wall, and also may be stacked so that they are angled from vertical. As known in the art, the blocks may be connected to each other by a pin attachment system, or the blocks may be provided with one or more protruding elements that interlock with one or more corresponding recesses in an adjacent block.

[0034] "Upper" and "lower" refer to the placement of the block in a retaining wall. The lower, or bottom, surface is placed such that it faces the ground. In a retaining wall, one row of blocks is laid down, forming a course. An upper

course is formed on top of this lower course by positioning the lower surface of one block on the upper surface of another block.

**[0035]** Retaining walls may be straight (i.e., substantially linear, as well as vertically straight), curved (serpentine) or may have sharp corners (i.e., 90 degree angles). Such walls can be angled from vertical. In this invention, reinforcing geogrid tie-backs or geosynthetic fabrics (also referred to generally as geogrids and geotextiles) may be used with retaining wall blocks. Regardless of the type of retaining wall, the veneer panel system should be easy to install, structurally sound, and meet or exceed all ASTM, IBC, and AASHTO requirements for retaining wall structures.

**[0036]** The veneer of this invention preferably comprises a mineral aggregate in fiberglass. This material is produced by mixing stone particles, sand, or mineral with resin, pouring this into a mold. Typically, particles of the type of stone that the panel is meant to resemble are used in the resin mixture, and these particles provide the color for the panel. For example, if the panel is intended to resemble natural granite, then granite particles are used in the mix. If limestone is the desired look, then fine particles of limestone may be used. Various powdered pigments may be added to the mix in order to create different colors or shades of color. The mold is configured to impart a surface texture to the material that resembles the texture of natural stone. After the mineral resin mix is added and spread across the mold, a mixture of glass fibers and resin is added into the mold. At this stage, structural components used to attach the panels to the surface that is being veneered may be added. Such components may be formed of pultruded fiberglass, and may be attached to the panel during the curing process in order to create a bond between the fiberglass panel and the structural component. After the resin has cured, the front surface of the panel preferably is sandblasted to remove resin from the surface, thus revealing a naturally-appearing mineral or stone surface. Alternatively, the front surface may be polished in order to produce a polished stone look.

**[0037]** It is to be emphasized that the surface of a panel may have any desired appearance. A natural appearance, such as stone, is generally most desirable. The panel may have a uniform appearance or it may have an ashlar pattern formed into it. The panels may also resemble stone that has been processed or treated as is commonly known in the natural stone industry. For example, the panel may resemble a weathered stone, polished stone, or flame treated stone. In addition, the mold may be configured to produce panels that resemble stone that has been hand or machine pitched or tumbled to produce an aesthetically pleasing natural quarried stone appearance.

**[0038]** The panels are produced in dimensions that are convenient to manufacture and handle. The panels may be planar but preferably have a slight curve molded at the edges so as to be used with various connecting elements, as described further below. Convenient panel sizes are about 8×18 inches (20.5 cm×45.7 cm), 16×48 inches (40.6×121.9 cm), and 32×48 inches (81.3×121.9 cm). The dimensions of the panel may vary from these stated dimensions in order to meet aesthetic or functional requirements of particular applications. These panels are relatively light in weight when compared to panels of granite. For example, a granite panel may weigh 400 to 500% more than a similarly sized panel of the present invention.

**[0039]** The back of the panel is provided with an attachment means so that the panel can be affixed to a wall. The resin/fiberglass composition of the panels allows a desired attachment means to be molded into the panel when it is formed, attached by adhesive, or attached by mechanical means such as screws and bolts. Attachment means include hooks, brackets, connection joints, connection channels, and the like. Preferred attachment mechanisms are described further below.

**[0040]** To create a veneer panel, several panels are installed next to each other over a wall. In a preferred embodiment, the panels are provided with tongue and groove attachment means so that two adjacent panels can be connected to each other. Preferably, each panel has two adjacent sides with a groove adapted to receive a tongue from corresponding sides of adjacent panels. Preferably, the attachment means provide a joint that discourages or minimizes penetration of water from rain or roadway spray. To attach a panel to the wall, a bracket, hook, connection joint or channel is molded into the back of the panel when it is manufactured. This then can be used to attach the panel to the wall by means of screws, bolts, pins, wire, nylon connectors or strapping or railings. Alternatively, and preferably, an interlocking element is molded onto the back of a panel when it is manufactured. This interlocking element mates with a corresponding interlocking element on the wall. The attachment means for the veneer panel preferably provides for flexibility when positioning the panels a distance from the wall. Because of irregularities in the underlying wall surface, it may be necessary or desirable to position the panels at various distances from a wall, and to allow for lateral positioning of the attachment means to accommodate curvature in the wall.

**[0041]** The panel of this invention is impervious to water and salt spray, is resistant to freeze-thaw degradation and UV degradation, and is relatively light in weight. As a result of these properties, the panel of this invention provides not only greater beauty, but enhances the durability of the underlying wall structure, since most concrete products become more vulnerable to freeze-thaw deterioration when salt water and freezing conditions are both present. After a panel wall has been installed, individual panels can be replaced if desired, which is a cost advantage if a portion of the surface of a wall has been damaged. The panels also are formed of a material that discourages graffiti since it has an irregular surface, and from which graffiti may be removed more readily since it does not absorb spray paint as readily as concrete. Use of the panels conceals any aesthetic problems with the wall, such as staining from red clay soils or from efflorescence.

**[0042]** The panels are useful when a wall is constructed from retaining wall blocks when it is desired to use a geogrid and to produce a simple, cost-effective and highly efficient connection between the geogrid and the wall. That is, because the wall surface will be concealed by the panels, the geogrid can be wrapped around the blocks, extending behind the blocks into the earth behind the wall. Thus the geogrid is in contact between the entire surfaces of adjacent blocks, as shown in FIGS. 9 to 12. Preferably, fabric is placed where the geogrid exits and re-enters the front face of the blocks to eliminate abrasion of the geogrid by the edges of the concrete block. Any cost-effective and suitably durable fabric of sheet material may be used for this purpose,



including woven or non-woven polyester fabric, vinyl sheeting, or plastic sheeting. The connection system may use a variety of geogrids or geofabrics for soil reinforcement.

**[0043]** Installation of the geogrid reinforcement of the present invention is accomplished by laying out the geogrid at the desired height on top of the course of block, but extra geogrid is provided at the face of the wall in a sufficient quantity that after succeeding courses of block are placed and backfilled, the geogrid may be pulled up over the succeeding courses and then laid back into the reinforced zone. The number of succeeding courses between geogrid layers is a function of products and the design principles used, but spacing of two or three courses is common. A protective fabric or sheet is placed between the geogrid and the block above and below the geogrid in order to protect the geogrid from abrasion. The geogrid may be placed in uniform lengths, or may be in different lengths if the wall design calls for the use of intermediate reinforcing using shorter reinforcement lengths between longer lengths.

**[0044]** As a result of the present invention, the geogrid completely encloses the blocks. This provides a highly efficient connection system that adds minimal cost to the wall structure when compared to existing solutions. It provides greater structural integrity to the finished wall, which is highly desirable in critical applications, and certainly in seismic zones.

**[0045]** Turning now to the Figures, the veneer panel system of this invention is shown and described.

**[0046]** **FIGS. 1 and 2** illustrate a preferred embodiment of the panel of this invention, in which the panels are provided with interlocking tongue and groove elements. The tongue and groove elements are shown extending the full length of the side to which they are attached, however, it is to be understood that the tongue and groove elements could extend over only a portion of the side of a panel. The tongue and groove elements, as well as adaptors **50**, are molded into the back of the panels during manufacture by setting the elements into resin before it is cured. **FIGS. 1A and 1B** show panel **10a** having curvilinear edges with tongues **11** and **12** along two adjacent sides and grooves **13** and **14** (shown in phantom) along the other two sides. **FIG. 2A** shows tongue element **11** and groove element **13** on the back of one panel and **FIG. 2B** shows how two of the panels are connected together by these elements.

**[0047]** **FIG. 3A** shows veneer panel system **20a** wherein panels **10a** are arranged in a running bond pattern over the surface of a wall. **FIG. 3B** shows veneer panel system **20b** wherein panels **10a** are stacked. **FIG. 4** shows another veneer panel system **30** wherein some panels (**10b**) have an ashlar appearance. The attachment means, shown in phantom, comprises adaptors **50** molded onto the backs of the panels and rails **100** attached to the wall by means of brackets. For simplicity, not all attachment means are shown.

**[0048]** **FIGS. 5A to 5C** illustrate how the panel system is attached to a wall. Rail **100** has a T-shape with body portion **101** and T-section **102**. Adaptor **50** with channel **52** fits over T-section **102** on rail **100**. Body portion **101** attaches to wall **W** by means of a connector, such as a bracket, though the body portion can be attached by any suitable means. Rail **100** has one or more slots or holes **103** to which bracket **110**

is attached and held secure through eyelet **112** by means of nut **120** and bolt **122**. Preferably, the distance of the rail from the wall can be varied. This permits an installer to produce an even or straight appearance for a wall which otherwise would have an irregular surface appearance, as happens occasionally in older walls that have experienced settling. The preferred way to adjust this distance from the wall is provided by screw threads **115** on segment **114** of the bracket **110**, on which eyelet **112** is adjustably mounted. Thus eyelet **112** can be positioned a desired distance away from the wall. Segment **116** is perpendicular to segment **114** and extends into the wall.

**[0049]** **FIGS. 6A to 6C** illustrate that rail **100** with T-section **102** can be used with another style of bracket. Hanging bracket **130** is formed onto rail **100** and is designed so that it interlocks with hanging element **140** molded to the top edge of panel **10c**.

**[0050]** **FIG. 7A** shows a portion of a retaining block wall comprising retaining wall blocks such as those described in commonly assigned, co-pending application U.S. Ser. No. 10/754,454, filed Jan. 9, 2004, hereby incorporated herein by reference. Blocks **70** are provided with channel **72** so that bracket **110** can fit between blocks. Rail **100** is provided with one or more slots **103**, which are sufficiently long to provide considerable flexibility in the vertical placement of the rail relative to the wall. Wire **105** feeds through eyelet **112** of bracket **110** (near the top of **FIG. 7A**). Bolt **120** and nut **122** attach the bracket to the rail (near the bottom of **FIG. 7A**).

**[0051]** **FIG. 7B** illustrates further how segment **114** (shown partially in phantom) of bracket **110** fits between the blocks in channel **72**. Segment **116** of the bracket extends into a cavity or core (such as core **74**) of the block, thus being positioned next to the block and held securely.

**[0052]** **FIGS. 8A and 8B** illustrate that an L-shaped bracket suitable to attach a rail to masonry wall **W**. Rail **100** is provided with one or more slots **103** (two slots are shown in **FIG. 8A**). L-angle bracket **160** has two sections **161** and **162** provided with a bore through which can be threaded bolts. Bolt **165** is held secure through section **162** by nut **166** and washer **167**. A second bolt **169** threads through the bore in section **161**, thus bolting the rail into the wall. A panel can then be attached to the rail as described above.

**[0053]** **FIG. 9** shows an exploded side view of three of blocks **80** that use a pin attachment system. Pin **85** has straight portion or shank **86** that fits into a pin hole (shown in phantom) and head **87** that extends above the surface of the block and into a recess in the block above. In this way, the pins stabilize the wall.

**[0054]** Similar blocks are used to form three courses of blocks, slightly set back from one another. **FIG. 9** illustrates the construction of retaining wall **200** wherein blocks **80** are laid onto a base leveling pad **202**. The bottom block is placed below grade. Behind the blocks is placed drainage rock. When using retaining wall blocks with geogrid **250**, a concern is that the edges of the blocks can abrade the geogrid. To prevent this, the edge of a course of blocks is provided with shield **220** to protect the geogrid from abrasion. Shield **220** comprises any suitable abrasion resistant material, such as vinyl, aluminum, steel, and the like, and is shaped to fit over the edge of course of blocks. Geogrid **250** is laid over the drainage rock and over the top (i.e., third) course of blocks.

[0055] Then, as shown in **FIG. 10**, three more courses of blocks are laid down. Soil is moved in behind the blocks and compacted. The geogrid then is laid over the top course of blocks, extending behind the wall, wrapping around three courses of blocks, thus forming geogrid wrap **255**. The geogrid is securely held in place after three more courses of blocks are laid down. The placement of geogrid wrap **255** in front of the retaining wall is exaggerated in **FIG. 10** in order to see it clearly. In use, it would be held close to the surface of the wall. **FIG. 10** also illustrates the positioning of second geogrid **250** over the topmost course of blocks.

[0056] **FIG. 11** shows the sectional view of a completed retaining wall with the veneer panel system **20** of this invention in place. The retaining wall has two geogrid wraps **255** and capping layer **212** that is provided with an overhang **213** under which veneer panel system **20** of this invention fits. Panels **10** are attached to rail **100** and held by bracket **110**. This can be more clearly seen in **FIG. 12**, in which retaining wall **200** has one geogrid wrap **255**. The veneer panel system is in a running bond pattern and is attached to rails **100**. Rails **100** attach to the wall by brackets **110**. For simplicity, only part of the wall is shown, and only one geogrid wrap is shown, though it is to be understood that more than one geogrid wrap can be used.

[0057] The veneer panel system of this invention is also suitable for use with other types of retaining wall systems. For example, as illustrated in **FIG. 13A**, multiple geogrids can be installed in a system that uses wire baskets filled with soil as retaining wall elements. A sectional view of a wall shows how geogrids are in place under each wire basket in wall **400**. Wire basket **410** is shown in **FIG. 13B**. This type of retaining wall is often intended to be temporary. The first wire basket is set down over compacted soil or base layer **402**, and geogrid **450** is laid down and attached to the wire basket. Soil and/or rocks are poured over this and compacted if necessary. Another wire basket and geogrid is put in place, filled with soil, and so on. The topmost layer can be a covering layer, such as plastic, or can be more soil or gravel. The veneer panel system of this invention is then installed by means of rails and brackets, as described above. A capping layer **420**, with recess **422** to receive the veneer system **20**, is used at the top of the wall.

[0058] Another alternative for temporary retaining wall use is shown in **FIG. 14**. In wall **500**, geogrid **550** is laid down over compacted soil or base layer **502**, dirt is placed on this, and the geogrid is laid back over the dirt to form geogrid wrap **555**. Veneer panel system **520** is attached by means of brackets **510** that extend between geogrid wraps.

[0059] The veneer panel system can also be used with walls in buildings, such as shown in **FIG. 15**, wherein the panels **10** form a partial wall finish, such as wainscoting **600** on the face of a building. Attachment means are as previously described.

[0060] **FIGS. 16A and 16B** show an angle bracket suitable to attach a rail **100** to a wall, such as wood frame **WF**. The angle bracket can be installed at one or more slots **103** and positioned as desired. Angle bracket **170** has base section **171** and a perpendicular section **172** both of which are provided with bores through which can be threaded bolts or screws. Bolt **175** is held secure through section **172** by nut **176** and washer **177**, thus attaching the bracket to the rail. Wood screws **179** thread through the bores in section **171**,

thus bolting the rail into the wall. A panel can then be attached to the rail as described above.

[0061] Although particular embodiments have been disclosed herein in detail, this has been done for purposes of illustration only, and is not intended to be limiting with respect to the scope of the following appended claims. In particular, it is contemplated by the inventors that various substitutions, alterations, and modifications may be made to the invention without departing from the spirit and scope of the invention as defined by the claims. For instance, the choices of materials or variations in shapes are believed to be a matter of routine for a person of ordinary skill in the art with knowledge of the embodiments disclosed herein.

What is claimed is:

1. A wall system comprising:

wall components for constructing a retaining wall;

a plurality of rectangular panels, each panel having a front surface and an opposed back surface defining a panel thickness, a set of opposed top and bottom edges and a set of opposed first and second side edges, the front surface comprising a mineral aggregate embedded in a resin; and

means for connecting the plurality of panels to the retaining wall formed from the wall components.

2. The wall system of claim 1, wherein the wall components are selected from natural stone, poured concrete, precast panels, masonry, landscape timbers, railroad ties, wall blocks, and combinations thereof.

3. The wall system of claim 1, wherein the wall components are wall blocks.

4. The wall system of claim 1, wherein the mineral aggregate is natural stone aggregate.

5. The wall system of claim 1, wherein the resin contains fiberglass.

6. The wall system of claim 1, wherein the means for connecting the plurality of panels to the retaining wall are selected from screws and bolts, hooks, brackets, connection joints, connection channels, and combinations thereof.

7. The wall system of claim 1, wherein each set of opposed panel edges has mating tongue and groove attachments, respectively, so that a respective tongue attachment and groove attachment of adjacent panels connect the adjacent panels.

8. The wall system of claim 1, wherein the means for connecting the plurality of panels to the retaining wall is molded into the back surface of the panel.

9. The wall system of claim 1, wherein the means for connecting the plurality of panels to the retaining wall include a first interlocking component on the wall that mates with a second interlocking component molded into the back surface of the panel.

10. The wall system of claim 1, wherein the first interlocking component is a rail.

11. The wall system of claim 10, wherein second interlocking component is a bracket that attaches to the rail.

12. The wall system of claim 11, wherein the rail is a longitudinal body with a T-shaped cross-section.

13. The wall system of claim 12, wherein the longitudinal body has slots to which the bracket attaches.

14. The wall system of claim 13, wherein the bracket has a channel that matingly fits over the T-shaped cross-section.

**15.** The wall system of claim 10, wherein the rail has a hanging bracket formed thereon and the second interlocking component has a hanging element molded to an edge of a panel.

**16.** A method of making a retaining wall including a plurality of wall blocks and geogrid comprising:

stacking wall blocks in one or more courses to form a first portion of the retaining wall, the first portion having a front wall surface and an upper course of blocks which forms an upper surface of the first portion;

placing the geogrid over the first portion of the retaining wall such that a first section of the geogrid extends behind the retaining wall and a second section of the geogrid extends in front of the retaining wall;

stacking wall blocks in one or more additional courses over the first portion of the retaining wall to form a second portion of the retaining wall, the geogrid extending between the upper surface of the first portion and a lower surface of the second portion of the retaining wall, the second wall portion having a front wall surface and an upper course of blocks which forms an upper surface of the second portion;

folding the geogrid back over the front and upper surfaces of the second portion so that the second section of the geogrid extends behind the retaining wall; and

stacking wall blocks in one or more additional courses over the second portion of the retaining wall to form a

third portion of the retaining wall, the geogrid extending between the upper surface of the second portion and a lower surface of the third portion of the retaining wall, the third wall portion having a front wall surface and an upper course of blocks which forms an upper surface of the third portion.

**17.** The method of claim 16 further comprising:

providing a plurality of panels; and

connecting the panels to the front surface of the retaining wall.

**18.** The method of claim 17, wherein the panels are formed of a mineral aggregate in fiberglass.

**19.** The method of claim 17, wherein one of adjacent first and second panels have tongue attachment means and another of adjacent first and second panels have mating tongue and groove attachment means, respectively.

**20.** The method of claim 19, wherein the tongue and groove attachment means are on opposing panel sides of adjacent first and second panels, respectively.

**21.** The method of claim 20, including interconnecting a tongue attachment means on a first panel with a groove attachment means on a second panel.

**22.** The method of claim 16, including placing a protective layer between the geogrid and an adjacent block.

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