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(54) **DRY-CAST CONCRETE BLOCK**

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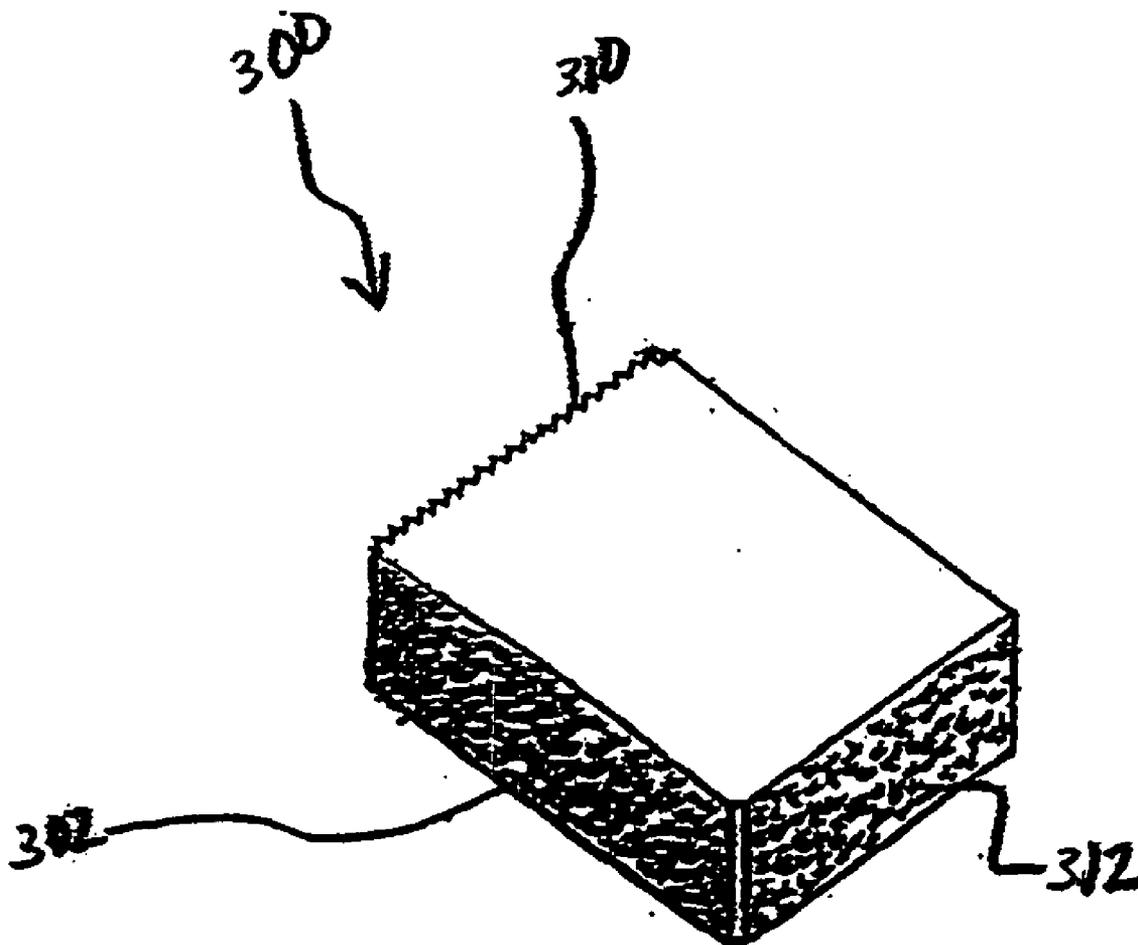
(57) **ABSTRACT**

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A concrete wall block manufactured using the dry cast process includes a top surface and a bottom surface. Opposing front and rear surfaces extend between the top surface and the bottom surface. Opposing first and second sidewall surfaces extend between the top surface and the bottom surface, and between the front and rear surfaces. The front surface and the first sidewall surface have a three dimensional texture imprinted thereon. The rear surface and the second sidewall surface may be smooth. The texturing on the front and first sidewall surfaces may generally resemble natural stone.

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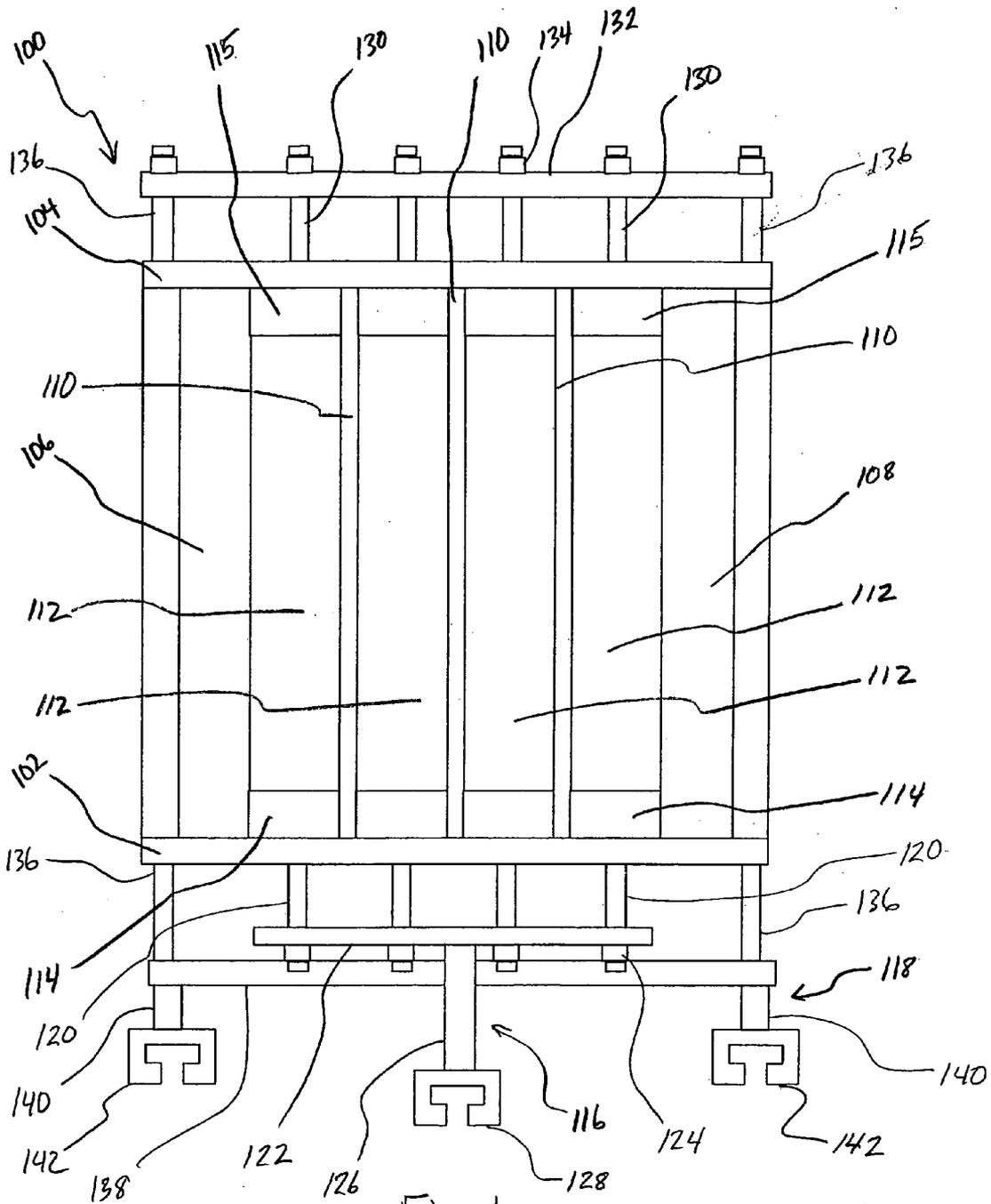


Fig. 1

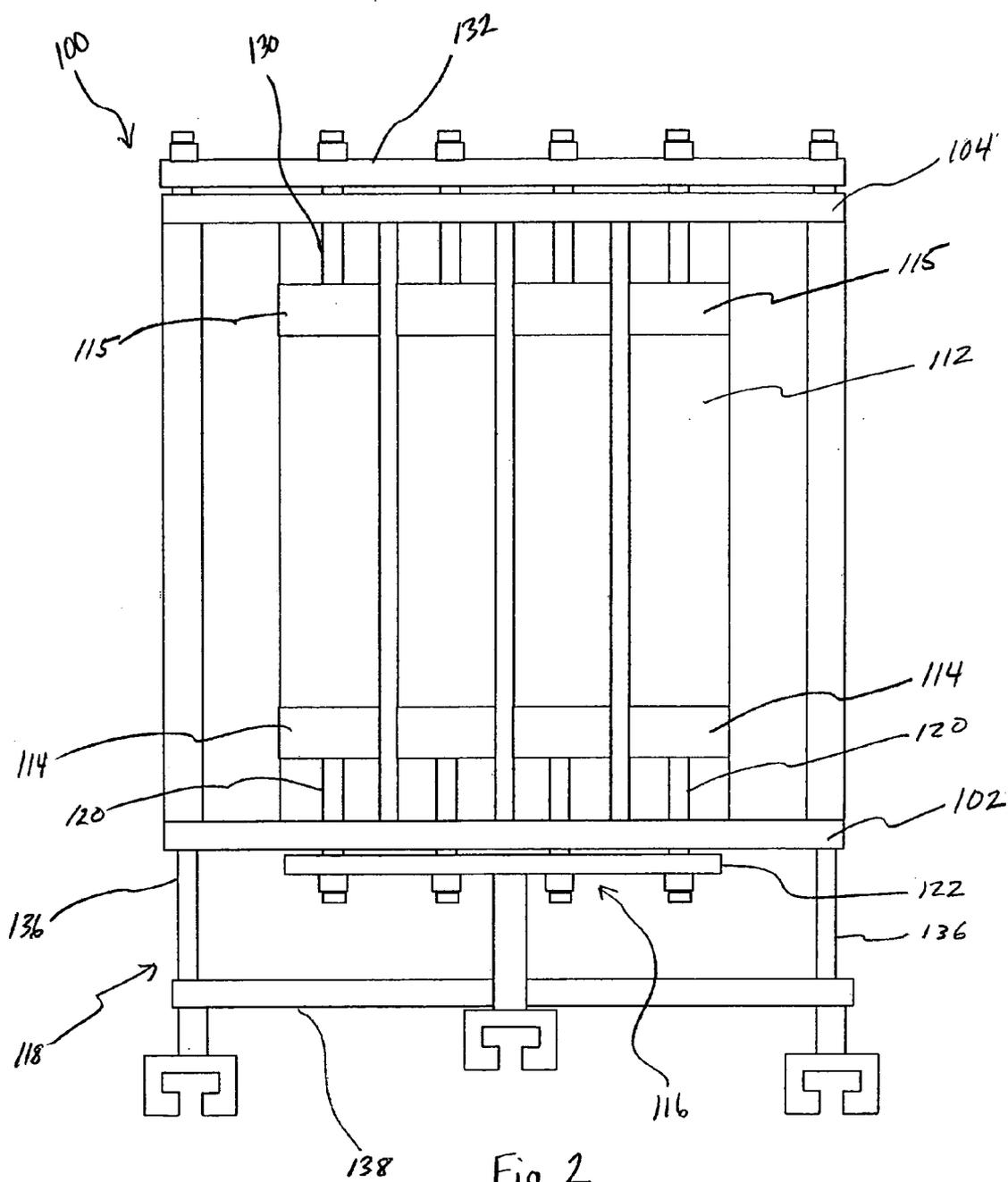


Fig. 2

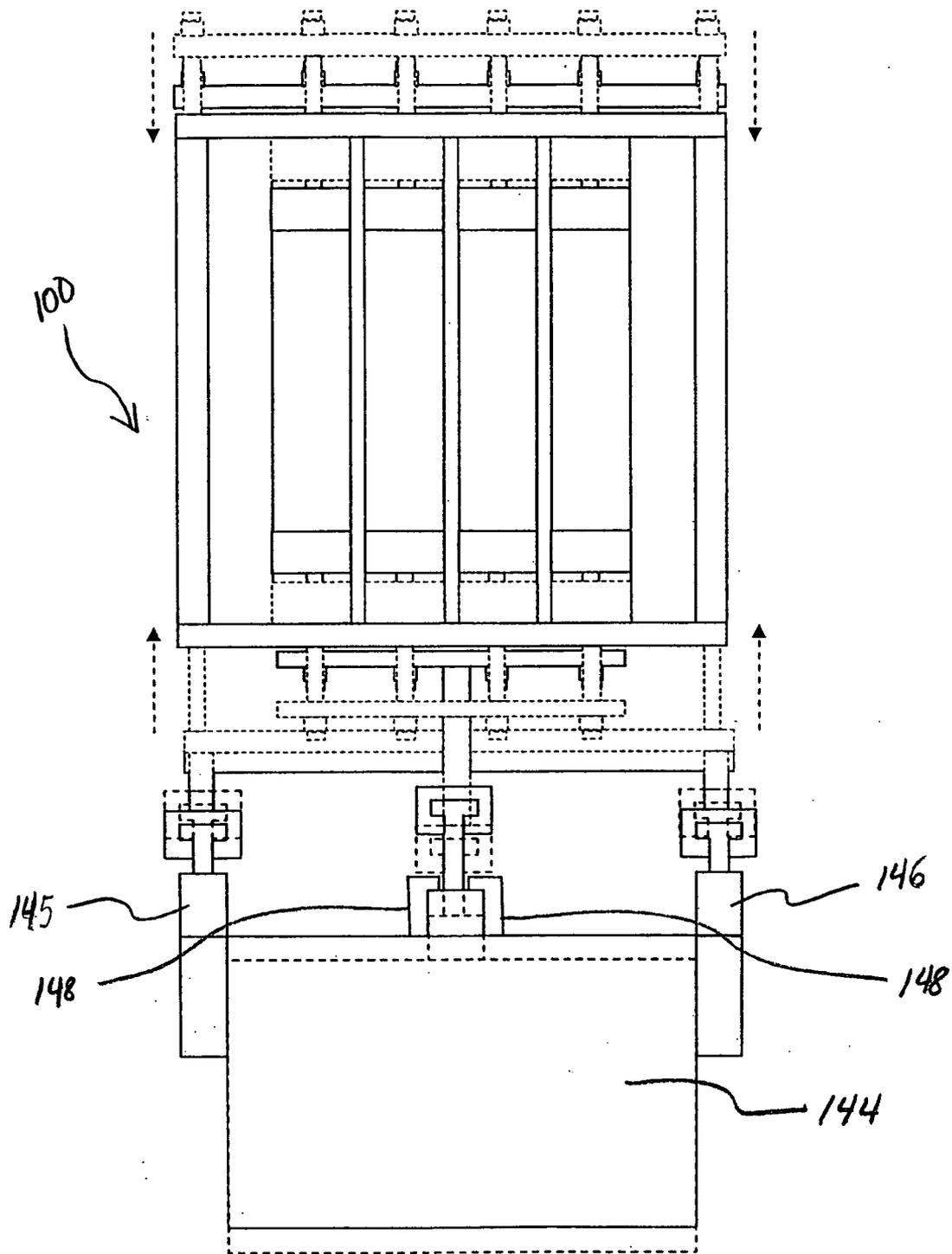


Fig. 3

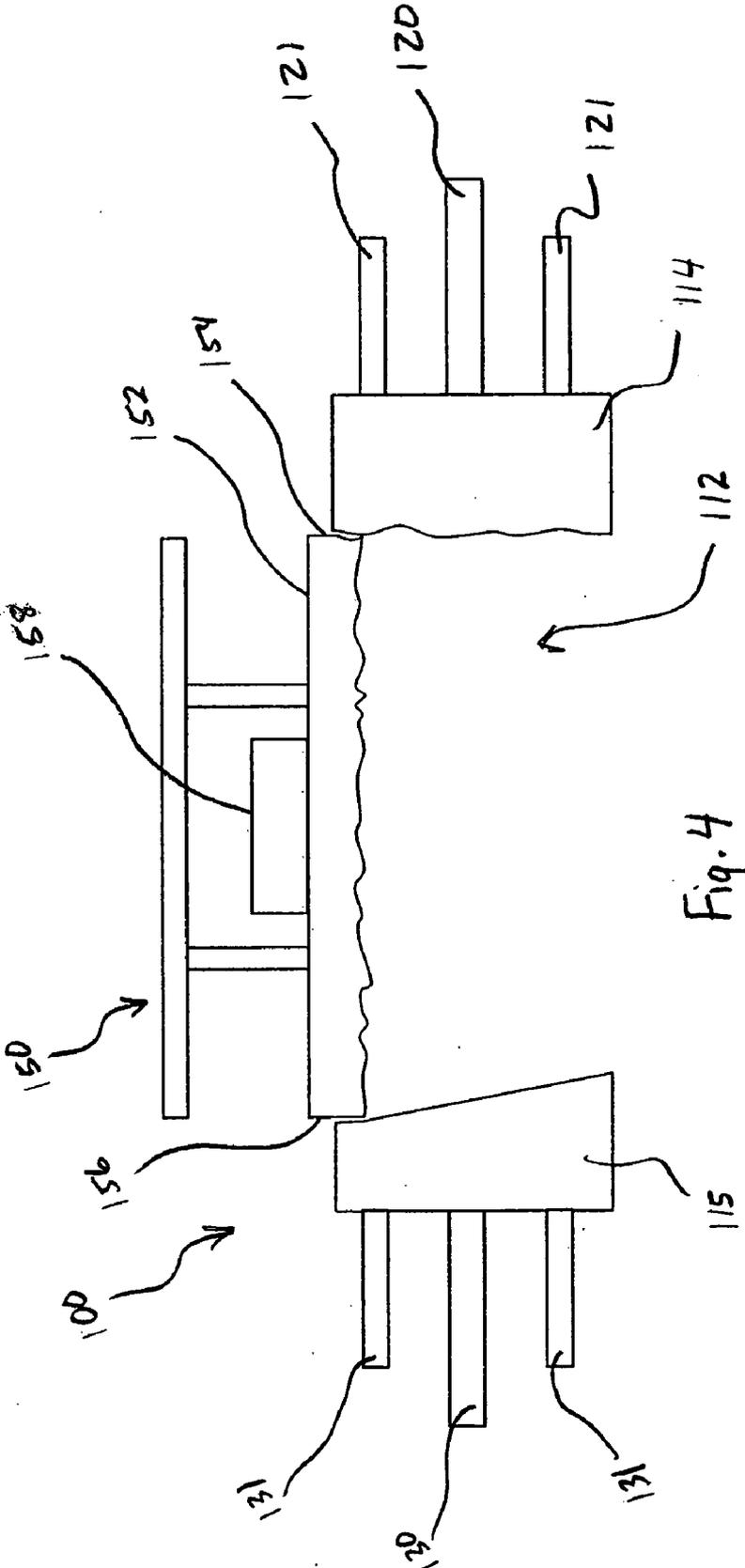


Fig. 4

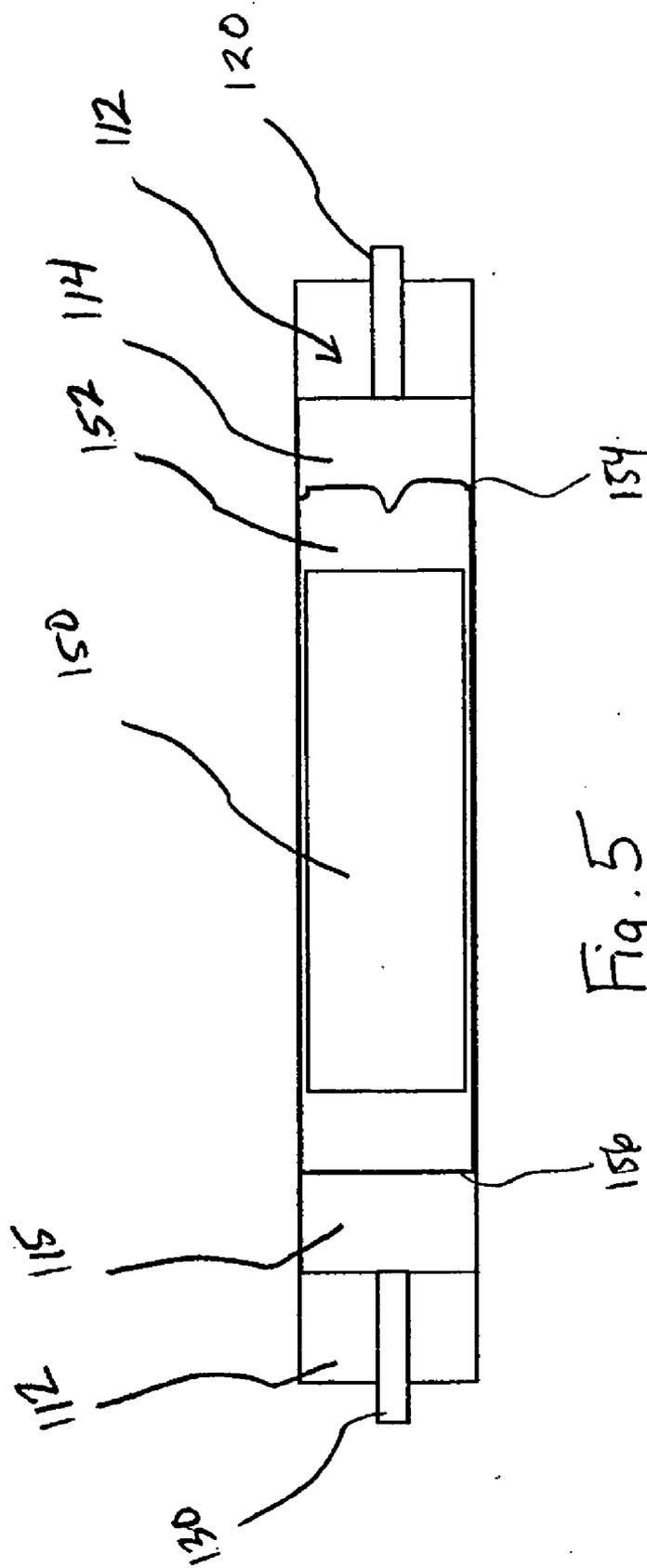


Fig. 5

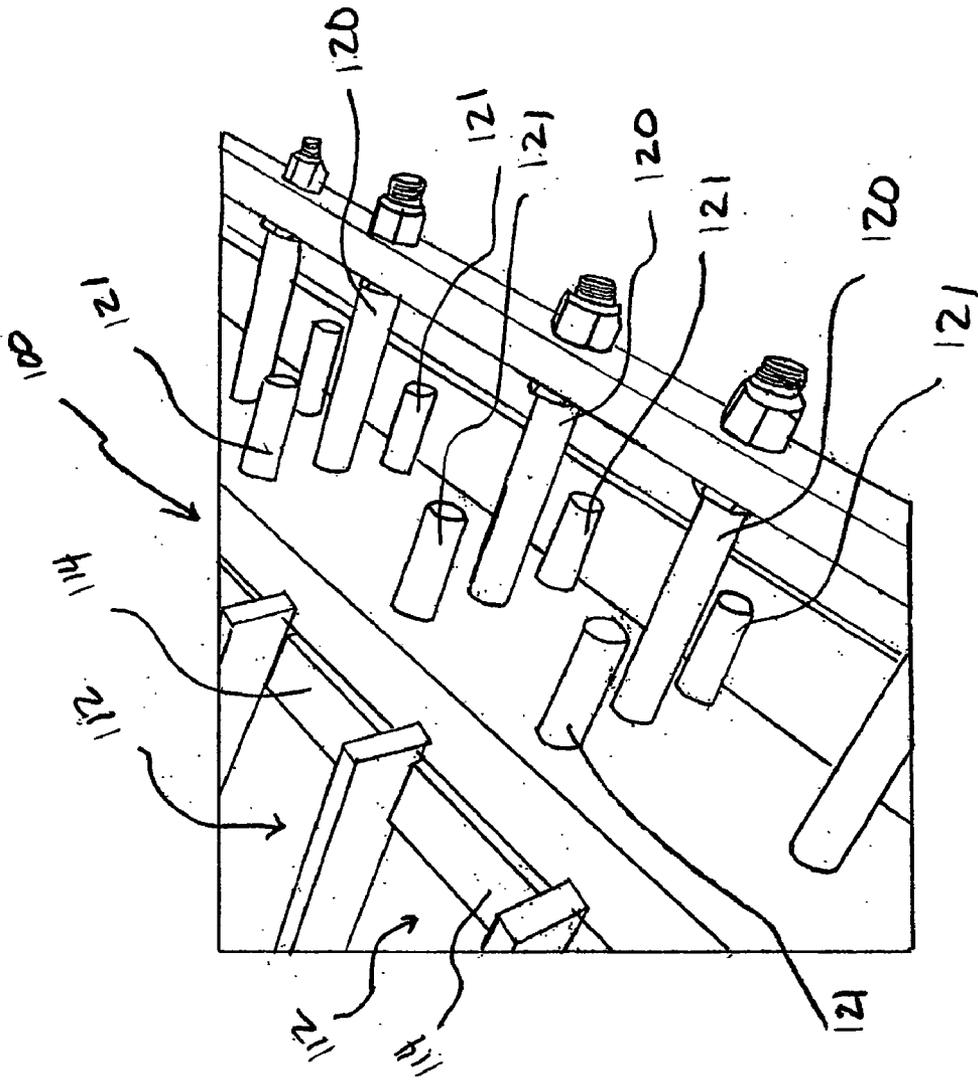


Fig. 6

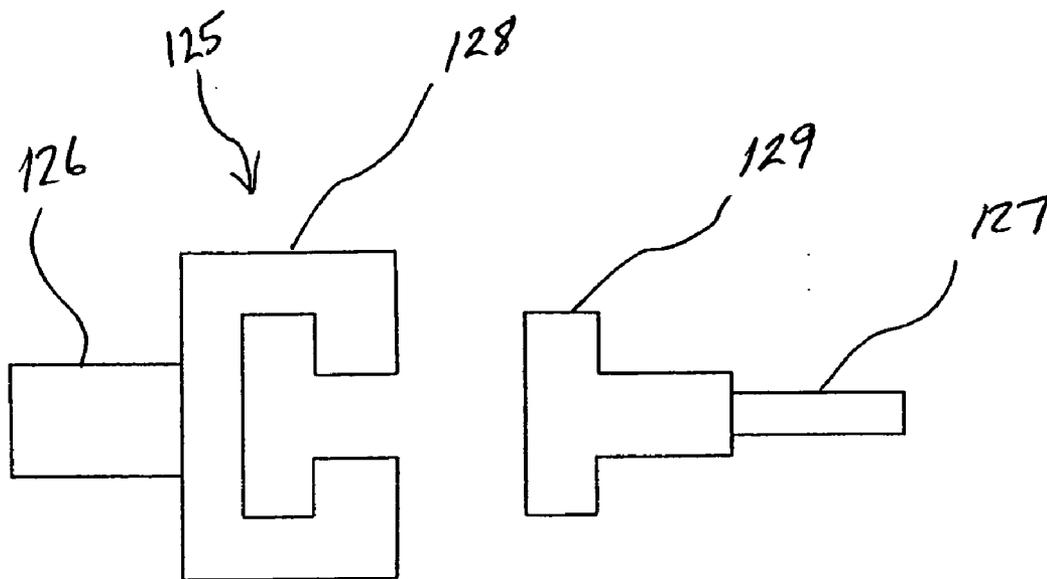


Fig. 7A

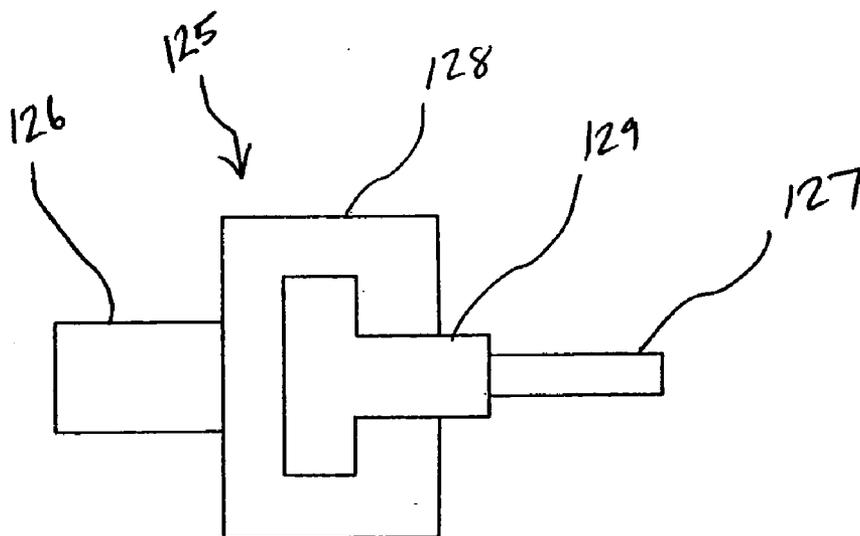


Fig. 7B

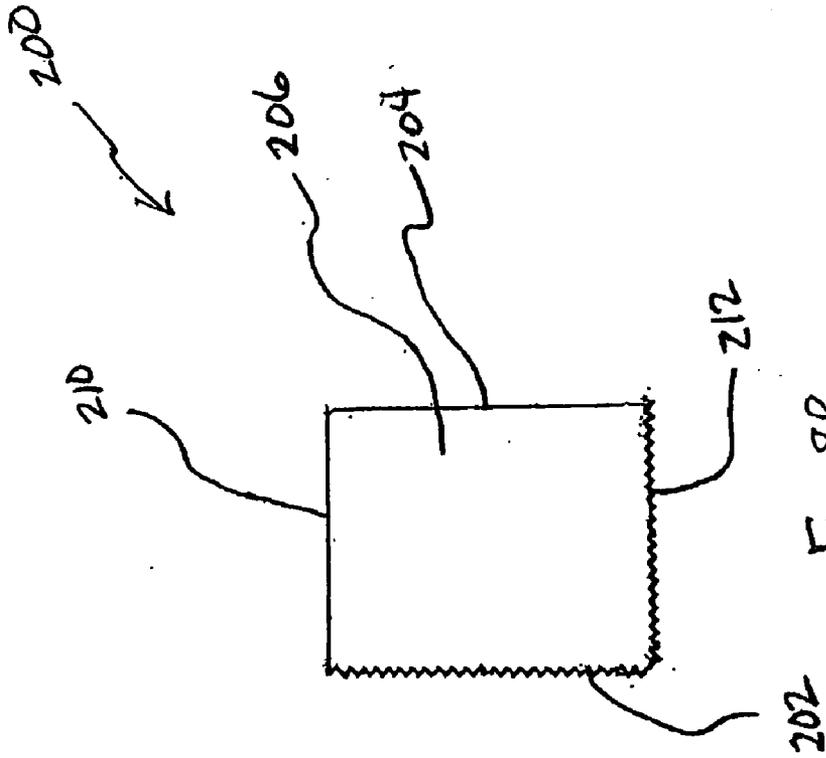


Fig. 8B

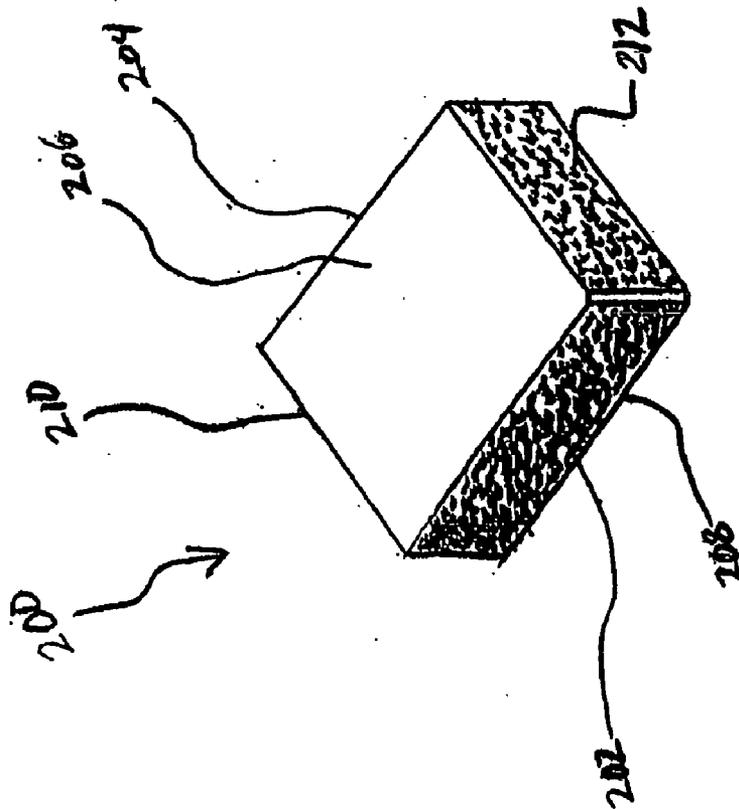


Fig. 8A

300

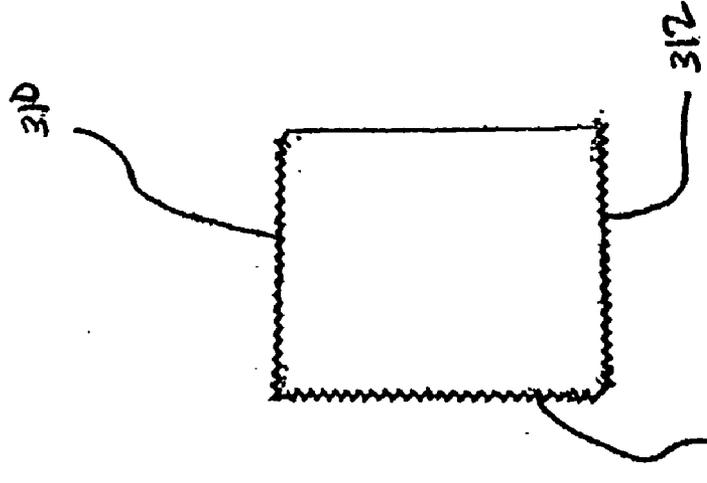


Fig. 9B

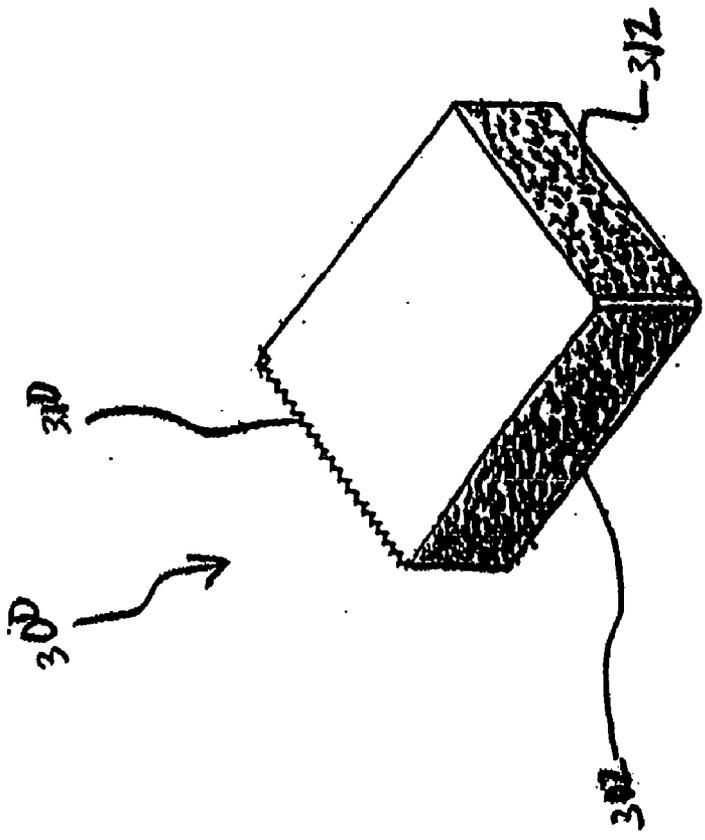


Fig. 9A

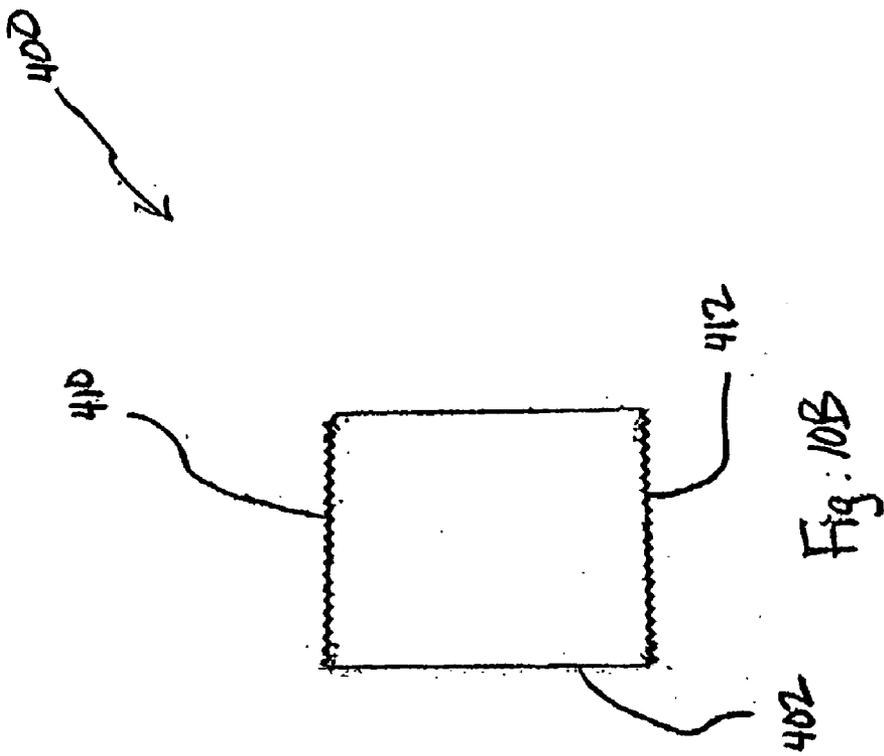


Fig. 10B

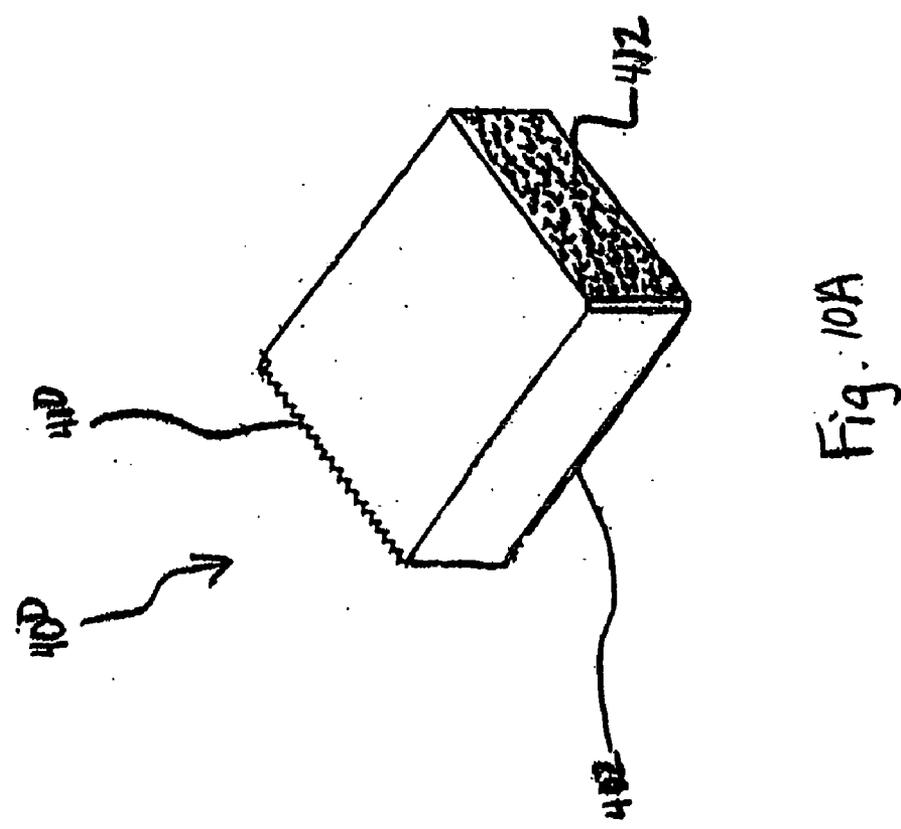


Fig. 10A

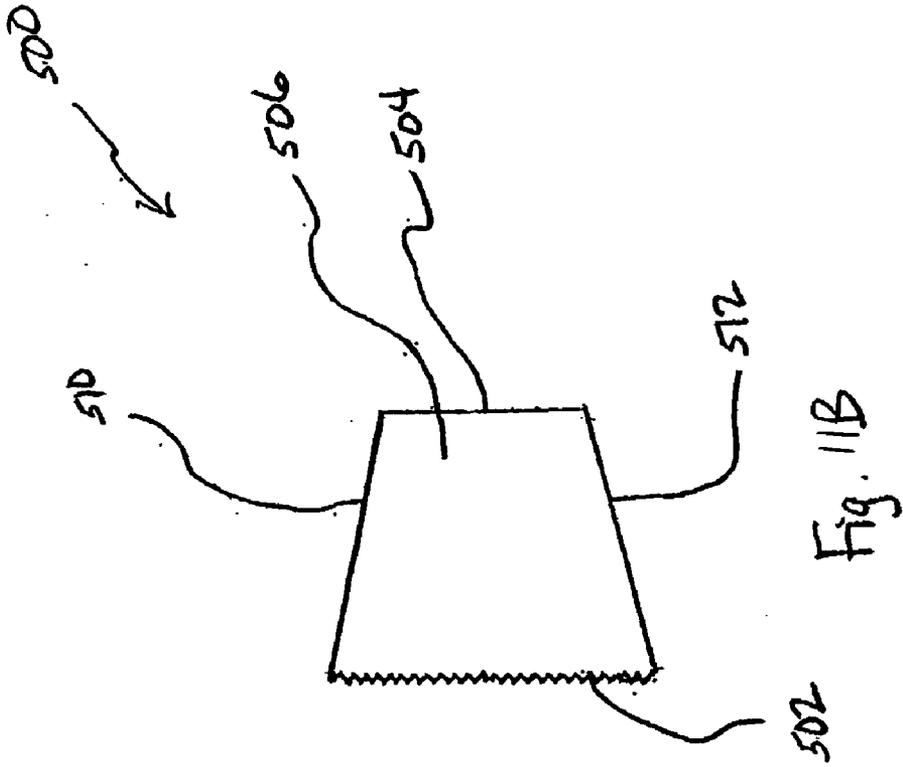


Fig. 11B

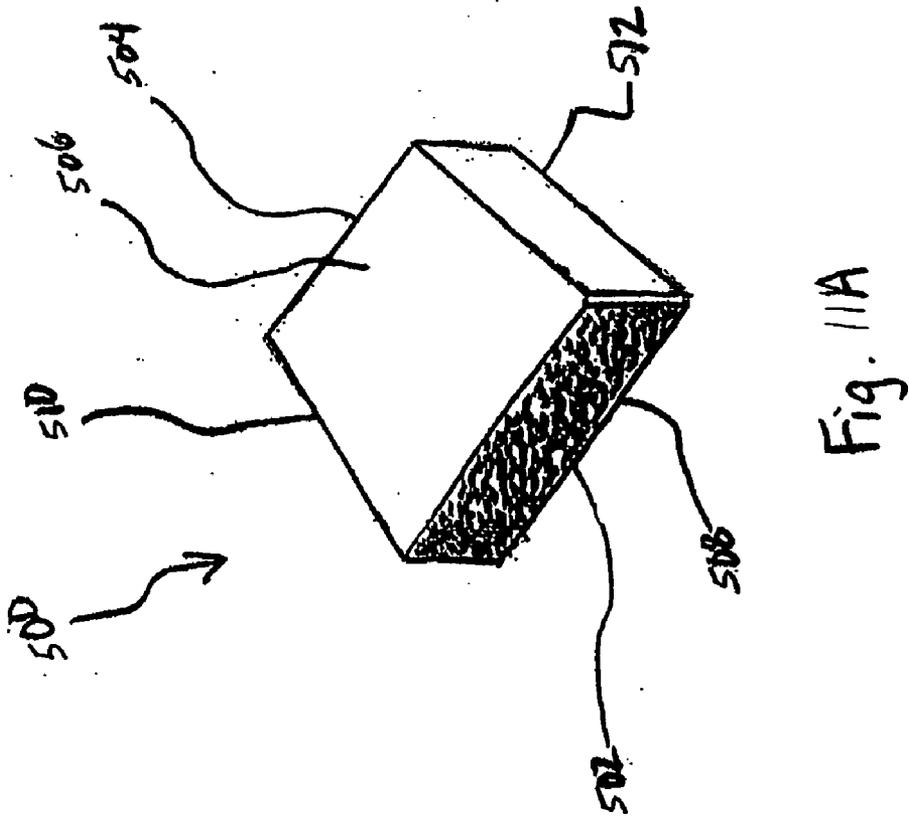


Fig. 11A

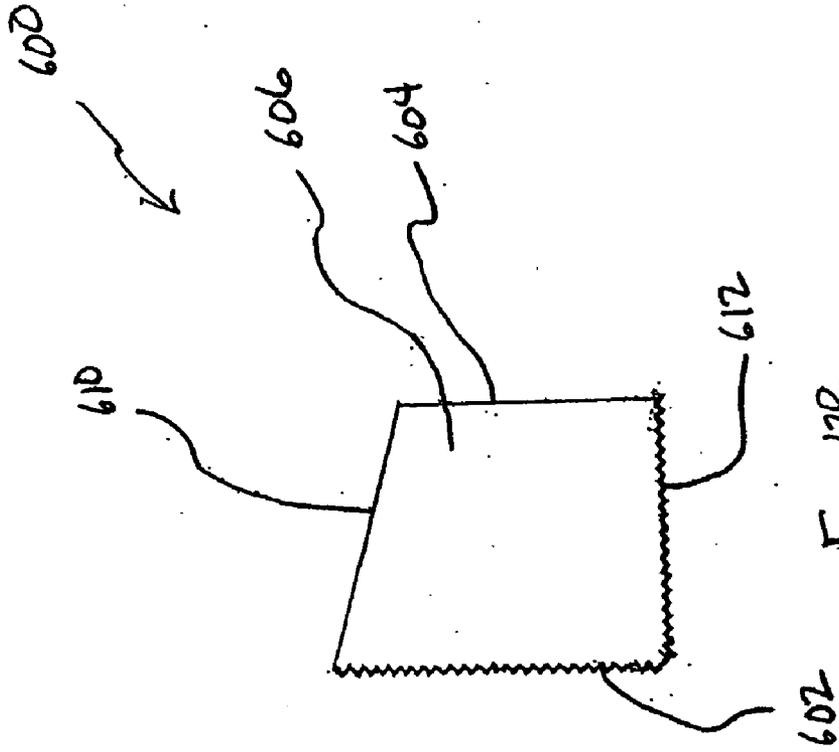


Fig. 12B

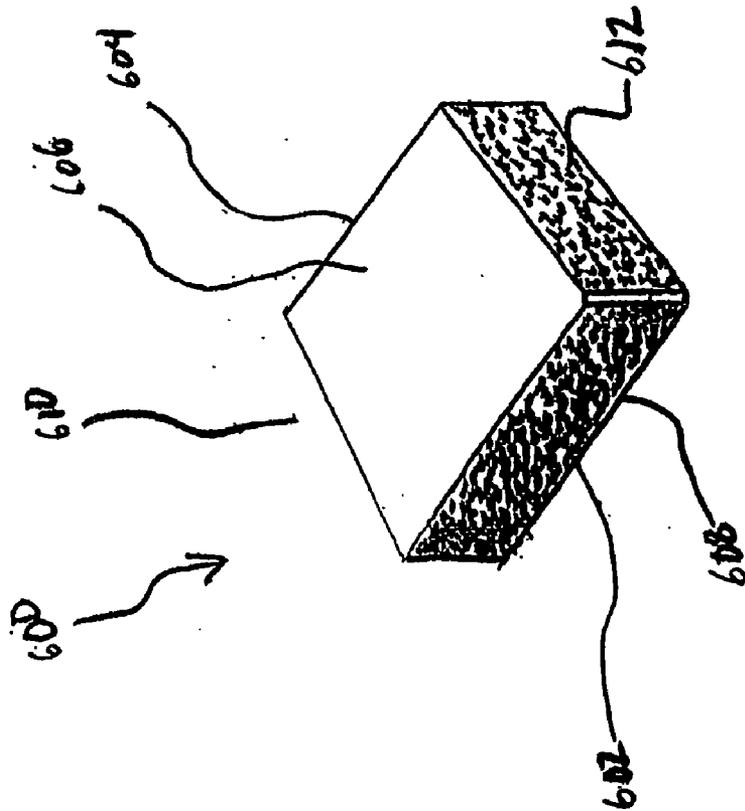


Fig. 12A

## DRY-CAST CONCRETE BLOCK

### FIELD OF THE INVENTION

[0001] The present invention relates generally to the manufacture of concrete wall blocks. More specifically, the present invention relates to the manufacture of concrete wall blocks using the dry-cast method wherein the blocks have two or more adjacent decorative faces.

### BACKGROUND OF THE INVENTION

[0002] Concrete blocks are used to form free standing and retaining walls. In such applications, the visible face or faces of the blocks are often provided with a textured or decorative appearance. Concrete blocks for forming walls are used in a variety of applications from small gardening applications to large-scale construction projects. Blocks are stacked in horizontal rows called courses. Multiple successive courses may be used to create a vertically rising wall of a desired height.

[0003] The concrete blocks used in constructing such walls are often manufactured using the dry cast process, which uses dry-cast block machinery to form blocks at a relatively high rate of speed. In a typical dry-cast block machine, material is fed into an open top mold from the top side. The conventional mold consists of stationary sides, to define the sidewalls of the block, and an open bottom. A removable pallet is used to temporarily close the open bottom of the mold and serve as a base during the block forming operation.

[0004] During manufacture, the material introduced through the open top collects on top of the pallet and is bounded by the end and side panels. A compression head is then pressed downwards under high pressure onto the material through the open top of the mold to compact the material therein. The head forces material into the mold so as to conform to the shape of the mold. The mold may also be vibrated during compaction to promote uniform compaction. The head may also be provided with one or more shoes that have relief defined therein in order to impart detail into the material that is contacted by the head's movement.

[0005] After compaction and vibration, the bottom pallet drops down, the head follows the pallet and the newly made product downward while the sides of the mold remain in position, and when the product clears the bottom of the mold, the pallet moves away from the mold and another pallet moves in place to make the next product. The head returns to its original position and the feed drawer brings more material into the mold to make the next product. The molding machinery is able to cycle several times per minute.

[0006] U.S. Pat. No. 5,827,015 teaches the use of conventional dry cast molding methods to form a twinned concrete slug in the molding machinery. The slug is then split into two blocks after being cured. It should be appreciated that the top surface of the finished wall block made according to the conventional dry cast manufacturing method is formed by the surface of the steel pallet. The bottom of the block is accordingly formed by the stripper shoe.

[0007] The need to eject the formed blocks through the bottom of the mold used in dry cast manufacture places limitations on the ability to create a decorative front face on the block because of the sidewalls of the mold shear across

the side surfaces of the block when stripped from the mold. Therefore, efforts have been made to provide for a decorative front face on concrete wall blocks.

[0008] One common current method of producing a wall block with a decorative front surface is to split a cured block (or a twinned slug) so that the front surface of the block has a fractured concrete surface that looks somewhat like split rock. This is done by forming a slug in a mold and providing one or more grooves in the slug to function as one or more splitting planes. The slug is then split apart to form two or more blocks. The appearance of the face of such block is exhibited by U.S. Pat. No. D380,560. This gives the front face of structures built with these blocks some visual depth that makes the structure look more natural. The number of facets and their arrangement can be varied to provide for different looks such as shown in U.S. Pat. No. D429,006.

[0009] More recent patents, such as U.S. Pat. No. 6,321,740, disclose modification of the splitter blade used in splitting the cured block to provide edges that appear more weathered. Splitting, however, adds additional production costs by requiring an additional step to the manufacturing process and results in waste material. Furthermore, split-faced concrete blocks do not sufficiently resemble natural stone to satisfy some consumer needs.

[0010] Another method to make blocks that have decorative front surfaces are described in U.S. Pat. Nos. 5,078,940; 5,217,630; and 6,224,815. These patents describe a method and an apparatus for manufacturing a concrete block having an irregular surface. The irregular surface can be made to look similar to split stone. This method includes pouring uncured block material into a mold cavity and causing a portion of the material to be retained in place relative to the cavity walls when the block is removed from the cavity. The result is a somewhat split appearance for the surface, without having to perform the splitting operation. However, the block produced from this method still does not satisfactorily resemble natural stone.

[0011] Other methods employed to provide for improved decorative appearance include spraying the front face of an uncured block to wash away some cement to leave exposed aggregate. Another method consists of "weathering" a cured block by tumbling it in a tumbler with tumbler chips that knock off random pieces of the block, which rounds the ends and creates a look closer to the appearance of weathered stone. These methods, however, are labor intensive and can damage the blocks, resulting in a higher overall cost of production.

[0012] Commonly owned, copending application Pub. No. US 2004/0218985, which is hereby incorporated by reference in its entirety, discloses an alternative method of providing a decorative simulated natural stone face to the front surface of a block while using the dry cast manufacturing method. The molding apparatus is configured such that the front surface of the block faces up in the mold and can therefore be provided with a pre-defined decorative face because the shoe stamps or contacts it directly. This process, however, limits the ability to provide for sidewalls that deviate from conformance to the smooth vertical sidewalls of the mold box because the downward movement of the block through the mold prevents a mold with stationary angled sidewalls or relief from being used.

[0013] U.S. Patent Pub. Nos. 2003/0126821 and 2003/0182011 disclose a block machine that stamps a face on the

front surface of a block while also providing a tapered sidewall to the block by use of pivoting sidewalls. However, this system does not teach the ability to impart a complex decorative face on the side surfaces of the blocks. In addition, the mold must be taken apart to a degree that makes it difficult to perform maintenance or repairs of the biasing mechanisms. This difficulty can cause undesirable delays in production. Accordingly, there remains a need to provide an improved machine and method of making dry-cast concrete blocks that is maintenance friendly and can produce blocks having complex decorative patterns on at least two adjacent faces.

#### SUMMARY OF THE INVENTION

[0014] The concrete wall block according to certain embodiments of the present invention provides advantageous adjacent decorative surfaces and can be manufactured using the dry cast process. Moreover, the decorative faces do not need to be formed by a secondary splitting, weatherizing or texturizing process after curing.

[0015] According to certain embodiments of the present invention, a concrete wall block manufactured using the dry cast process includes a top surface and a bottom surface. Opposing front and rear surfaces extend between the top surface and the bottom surface. Opposing first and second sidewall surfaces extend between the top surface and the bottom surface, and between the front and rear surfaces. The front surface and the first sidewall surface have a three dimensional texture imprinted thereon. The rear surface and the second sidewall surface may be smooth. The texturing on the front and first sidewall surfaces may generally resemble natural stone.

#### BRIEF DESCRIPTION OF THE FIGURES

[0016] FIG. 1 is a top view of a mold apparatus according to an embodiment of the present invention in a first position.

[0017] FIG. 2 is a top view of a mold apparatus according to an embodiment of the present invention in a second position.

[0018] FIG. 3 is a top view of a mold apparatus according to an embodiment of the present invention showing both the first and the second position.

[0019] FIG. 4 is a side view of a pair of end liners and a compression head assembly according to an embodiment of the present invention.

[0020] FIG. 5 is a top view of a pair of end liners and a compression head assembly according to an embodiment of the present invention.

[0021] FIG. 6 is a partial perspective view of a mold apparatus according to an embodiment of the present invention.

[0022] FIG. 7A and FIG. 7B are top views of a floating connection according to an embodiment of the present invention.

[0023] FIG. 8A is a perspective view and FIG. 8B is a top view of a concrete block according to an embodiment of the present invention.

[0024] FIG. 9A is a perspective view and FIG. 9B is a top view of a concrete block according to an embodiment of the present invention.

[0025] FIG. 10A is a perspective view and FIG. 10B is a top view of a concrete block according to an embodiment of the present invention.

[0026] FIG. 11A is a perspective view and FIG. 11B is a top view of a concrete block according to an embodiment of the present invention.

[0027] FIG. 12A is a perspective view and FIG. 12B is a top view of a concrete block according to an embodiment of the present invention.

#### DETAILED DESCRIPTION

[0028] Referring to FIGS. 1-3, there can be seen a dry-cast block mold 100 according to an embodiment of the present invention. FIG. 1 depicts block mold 100 in the “release” or “strip” position. FIG. 2 depicts block mold 100 in the “fill” position. Both the strip position and the fill position are shown in FIG. 3, with the strip position shown in dashed lines and the fill position shown with solid lines.

[0029] Dry-cast block mold 100 is generally comprised of a pair of side bars 102, 104 and a pair of side plates 106, 108 that define an open interior region. Division plates 110 span side bars 102, 104, creating multiple mold cavities 112. A front end liner 114 and a rear end liner 115 are disposed in each mold cavity 112. One of skill in the art will recognize that the number of divider plates may be varied to increase or decrease the number of mold cavities, and accordingly, the respective number of end liners.

[0030] Front end liners 114 are connected and controlled by a front end liner connector assembly 116. Front end liners 114 are each connected to a front end liner push member 120. Front end liner push members 120 are coupled to one another by a front end liner push bar 122, to which each front end liner push member 120 is connected with a fastener 124. An actuator attachment member 126 and floating connector 128 are also connected to front end liner push bar 122. An actuator 144 attached to actuator attachment member 126 can therefore control all front end liners 114 simultaneously.

[0031] Rear end liners 115 are actuated by a rear end liner connector assembly 118. Rear end liners 115 are connected to rear end liner push members 130 which are linked to one another by a rear end liner push bar 132 to which they are attached with fasteners 134. Rear connector members 136 are similarly attached to rear end liner push bar 132 and run along side plates 106, 108 where they connect to a connector bar 140. Also attached to connector bar are two actuator attachment members 140 with floating connectors 142 to which actuators 145, 146 can be attached to control movement of rear end liner connector assembly 118. Actuators 145, 146 attached to actuator attachment members 140 can therefore control all rear end liners 115 simultaneously.

[0032] Referring to FIGS. 4 and 6, each front end liner 114 is also attached to a pair of guide members 121 that are aligned parallel to end liner push members 120. Similarly, each rear end liner 115 is attached to a pair of guide members 131. Guide members 121, 131 are function to maintain the alignment of end liners 114, 115 and to resist rotational forces throughout the molding process.

[0033] Mold box 100 will generally rest in the strip position shown in FIG. 1 when the machine is idle. The machine is moved into the fill position depicted in FIG. 2 so

that it can be filled with dry-cast concrete mixture. This is done by actuating a front end liner actuator **144** attached to front end liner connector assembly **116** that pushes front end liners **114** forward towards the middle of cavities **112**. Rear actuators **145**, **146** attached to rear end liner connector assembly **118** also pull rear end liners **115** forward towards the middle of cavities **112**. The mold cavities **112** are then filled with mold material and the actuators **144**, **145**, **146** hold the end liners **114**, **115** in place while the mold is filled, vibrated and compacted. When the mold material is stripped from the mold, front end liners **114** are pulled back and rear end liners **115** are pushed back to the strip position by their respective actuators **144**, **145**, **146**.

[0034] Actuators **144**, **145**, **146** move front end liners **114** and rear end liners **115** in opposite directions at the same time. Front actuator **144** and rear actuators **145**, **146** are thus operated out of phase from one another, because while one end liner set is pushed the other is pulled. Front actuator **144** is preferably a core puller, such as those sold by Besser Company of Alpena, Michigan. The normal stroke of such a core puller, which is about 19 inches, is limited by a mechanical stop **148** which confines the core puller's stroke to about 2 inches. Rear actuators **145**, **146** are preferably 2" air cylinders attached to the core puller's frame. One of skill in the art will recognize that numerous other front and rear actuators may be used, for example, hydraulically actuated cylinders or other pneumatically actuated cylinders. Gear or linkage based actuators may also be used without departing from the scope of the present invention.

[0035] Referring to FIGS. **4** and **5**, the outside edges of the head shoe **154**, **156** of the head assembly **150** are given cooperating relief to the top portion of the faces of each pair of end liners **114**, **115**. This configuration allows both the head shoe **152** and the end liners **114**, **115** to fully contact the mold material, and thus impart a higher quality face, when the end liners **114**, **115** are in the fill position and the head shoe **152** is being used to compress the material. It will be appreciated that the use of both a head shoe and end liners to provide a face to the block allows a block to be produced that has a decorative appearance on as many as three consecutive sides.

[0036] End liners **114**, **115** may be used to either impart a decorative pattern or to provide a taper to the block sides as the user desires. Although depicted in FIGS. **4** and **5** as having tapered end liners **115** on one side and faced end liners **114** on the other, mold box may have identical end liners on both of its ends. In one preferred configuration, a smooth non-tapered end liner is used on one side while the opposing end liner includes three dimensional relief to imprint three dimensional texture in the side face adjacent to the top face. It should be appreciated that a portion of the side of the head shoe **152** may need to be provided with complimentary relief to conform to the relief in end liner **114**. Otherwise, a tight tolerance between the head shoe **152** and end liner **114** will not be possible and material may undesirably flow into the gap formed therebetween during the forming process.

[0037] End liners **114**, **115** can provide decorative appearances with greater detail and relief than can be provided using conventional techniques, such as splitting and tumbling. Such decorative appearances include broken rock, stacked rocks, natural stone, brick, striated or roughened

texture. Persons of skill in the art of concrete block manufacturing using the dry-cast process will recognize that various decorative appearances can be imparted on the front surfaces of the blocks, and that the present invention is not limited to a specific decorative facial appearance unless specifically indicated in a given Claim.

[0038] To prevent concrete material from accumulating on faced end liners **114** and degrading the quality of the decorative appearance imparted to the block surface, end liners **114** may be heated. Heat is provided to end liners **114** by operatively connecting at least one heat element (not shown) to end liners **114**. Suitable heat elements include resistance elements that may be hard wired, solid state, or semiconductor circuitry. Head shoe **152** may also be provided with a heat source **158**, as is known in the art. The divider plates and mold cavities may also be heated.

[0039] Each actuator is connected to an end liner connector assembly by a floating connector **125** depicted in FIGS. **7A** and **7B**. Floating connector **125** includes a female portion **128**, which is connected to end liner connector assembly by an attachment member **126**, and a male portion **129**, which is connected to actuator by an attachment member **127**. To connect, the male connector portion **129** simply slides into the female connector portion **128** downwardly from the top surface of female portion **129** or upwardly from the bottom surface of female portion **129**. Floating connector **125** allows for up and down vibration during the molding process, but constrains movement in the front to back and side to side directions. This holds the assembly in place to allow end liners to impart relief in the mold material, but allows sufficient motion to minimize the likelihood of failure of the connecting members.

[0040] Referring to FIGS. **8A-8B**, there can be seen an embodiment of a concrete block **200** that can be made using the dry cast block mold **100** according to an embodiment of the present invention. Block **200** comprises a front surface **202** and opposing rear surface **204**, a top surface **206** and opposing bottom surface **208**, and opposing first **210** and second **212** side surfaces. Front surface **202** has a decorative appearance imparted by the head shoe because front surface **202** faces up in the mold. Side surface **212** has a decorative design imparted by either a front or rear end liner having decorative relief defined therein. End liner **114** of FIG. **4** can be used to make the decorative side surface **212** shown in FIGS. **8A** and **8B**. The opposing end liner is smooth to provide for a smooth side surface **210**. Alternatively, as shown in FIGS. **9A** and **9B**, block **300** may be provided with decorative faces on front surface **302** and both first **310** and second **312** side surfaces. This is done by providing the mold with both front and rear end liners having decorative relief. A further alternative, shown in FIGS. **10A** and **10B**, is to provide a block **400** with decorative side surfaces **410** and **412** and a smooth front surface **402**. In such an application, textured front and rear end liners are used while the head shoe is smooth to create a smooth front surface. The pattern given to decorative faces can vary depending on the desired appearance for a particular wall or wall section, as explained previously. Decorative faces in a particular block may have the same or different appearance.

[0041] FIGS. **11A-11B** depict another embodiment of a concrete block **500** that can be made using the dry cast block mold **100** according to an embodiment of the present inven-

tion. Block 500 comprises a front surface 502 and opposing rear surface 504, a top surface 506 and opposing bottom surface 508 and opposing first 510 and second 512 side surfaces. Front surface 502 has a decorative appearance imparted by the head shoe. Side surfaces 510, 512 are both tapered. Blocks with one or more tapered side surfaces are particularly adapted to create serpentine or otherwise curved walls. End liners similar to the end liner 115 depicted in FIGS. 4 and 5 are used to make such a block 500.

[0042] FIGS. 12A-12B depict a concrete block 600 that includes a decorative front surface 602 with an opposing rear surface 604, a top surface 606 and opposing bottom surface 608, and first 610 and second 612 opposing side surfaces. This block 600 is formed, however, using one textured face end liner and one smooth tapered end liner, such that side surface 612 is tapered and side surface 610 has a decorative appearance.

[0043] Blocks made according to the present invention may also be provided with an interlocking extension to facilitate stacking of blocks and create a setback between courses of blocks. A mold for creating such a block is disclosed in commonly-owned copending application Pub. No. 2004/0218985, incorporated by reference above. To modify the mold of the present invention to produce blocks with protrusions in addition to multiple faces or tapers, a notch in the shape of the desired protrusion is added to the division plates as disclosed in the above publication.

[0044] The foregoing is considered as illustrative only of the principles of the invention. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described. While the preferred embodiment has been described, the details may be changed without departing from the invention, which is defined by the Claims.

What is claimed is:

- 1. A dry-cast concrete wall block comprising:
  - a top surface;
  - a bottom surface opposing front and rear surfaces extending between the top surface and the bottom surface; and
  - opposing first and second sidewall surfaces extending between the top surface and the bottom surface, and extending between the front and rear surfaces wherein the front surface and the first sidewall surface have a three dimensional texture imprinted thereon.
- 2. The concrete wall block of claim 1, wherein the rear surface and the second sidewall surface are smooth.
- 3. The concrete wall block of claim 1, wherein the texturing on the front and first sidewall surfaces generally resembles natural stone.
- 4. The concrete wall block of claim 1, wherein the texturing of the front and first sidewall surfaces covers their entire extent.
- 5. The concrete wall block of claim 1, further comprising an interlocking protrusion extending below the bottom surface of the block.
- 6. A dry-cast concrete wall block comprising:
  - a top surface;
  - a bottom surface spaced apart from the top surface and defining a thickness of the block;

- a first side surface extending between the top surface and the bottom surface, the first side surface having a three dimensional texture imprinted thereon;
  - a second side surface extending between the top surface and the bottom surface, the second side surface having a three dimensional texture imprinted thereon;
  - a third side surface extending between the top surface and the bottom surface, the third side surface opposing the second side surface;
  - a fourth side surface extending between the top surface and the bottom surface, the fourth side surface opposing the first side surface.
- 7. The concrete wall block of claim 6, wherein the third side surface is tapered.
  - 8. The concrete wall block of claim 6, further comprising an interlocking extension extending below the bottom surface.
  - 9. A dry-cast concrete wall block comprising:
    - a top surface;
    - a bottom surface spaced apart from the top surface and defining a thickness of the block;
    - a front surface extending between the top surface and the bottom surface;
    - a rear surface opposite the front surface and extending between the top surface and the bottom surface; and
    - opposing side surfaces spanning between the front and back surfaces, wherein the front surface and one of the opposing side surfaces are configured to simulate natural stone.
  - 10. A method of manufacturing an uncured concrete block made using the dry-cast manufacturing process, the method comprising the steps of:
    - providing a mold, the mold comprising a pair of side walls, a pair of end walls, an open top side and an open bottom side defining a mold cavity;
    - providing a pallet;
    - providing an end liner within the mold cavity;
    - positioning the pallet with respect to the mold to temporarily close the open bottom side of the mold during a portion of the manufacturing process;
    - moving each a first end liner from a strip position to a fill position;
    - introducing a dry casting concrete mixture to the mold through the open top side;
    - vibrating the concrete mixture within the mold;
    - compacting the concrete mixture within the mold by pressing on the concrete mixture with at least one shoe attached to a compression head to impart a decorative face on the concrete mixture;
    - moving each the first end liner from the fill position to the strip position; and
    - releasing the concrete mixture from the mold by moving the pallet relative to the mold.

11. The method of claim 10, further comprising the step of forming a decorative pattern on a side face of the uncured concrete block with the first end liner.

12. The method of claim 10, further comprising the step of forming a tapered side face on the uncured concrete block with the first end liner.

13. The method of claim 10, further comprising the step of providing a second end liner to each mold cavity disposed opposite the first end liner.

14. The method of claim 10, further comprising the step of heating the first end liner.

15. The method of claim 10, further comprising the step of providing a division plate within the mold to define multiple mold cavities.

\* \* \* \* \*