Title: MASONRY BLOCKS AN METHOD OF MAKING MASONRY BLOCKS HAVING OVERLAPPING FACES

Abstract: A masonry block molded by a masonry block machine employing a mold assembly having a plurality of liner plates, at least one of which is moveable; the masonry block including a first transverse face, a second transverse face opposing the first transverse face, a first major face joining the first transverse face to the second transverse face, a second major face opposing the first major face and joining the first transverse face to the second transverse face, a first end face joining the first major face to the second major face, and a second end face opposing the first end face and joining the first major face to the second major face, wherein the first end face comprises a non-planar face configured to engage and overlap with a non-planar end face of a similar masonry block and is formed during a molding process through action of a moveable liner plate having a negative of the non-planar end face.
MASTONRY BLOCKS AND METHOD OF MAKING MASONRY
BLOCKS HAVING OVERLAPPING FACES

Cross-Reference to Related Application
The subject matter of this application is related to the subject matter of
U.S. Provisional Patent Application No. 60/644,106, filed January 13, 2005,
priority to which is claimed under 35 U.S.C. § 119(e) and which is incorporated
herein by reference.

The Field of the Invention
The present invention relates generally to masonry blocks, and more
particularly to masonry blocks and methods of making masonry blocks having at
least one non-planar face configured to overlap with a non-planar face of a
similar masonry block.

Background of the Invention
Concrete blocks, also referred to as concrete masonry units, are
employed to construct any number of structures. Examples of concrete masonry
units include hollow core blocks, typically referred to as “gray” blocks, paving
blocks, and retaining wall blocks. Gray blocks are commonly used in the
construction of commercial and institutional building, and are now even being
used in the construction of single family homes. Retaining wall blocks are used
to build any number of landscape structures, such as, for example, raised
planting beds and soil retention walls.

These blocks are generally rectangular in shape such that when stacked
together in off-set courses to form a wall or other structure, a brick-like pattern
familiar to everyone is formed by the joint lines between adjacent blocks. Figure
20A is an illustrative example of a portion of a wall structure 880 constructed
using conventional gray blocks 890 (see Figure 20B) and having the familiar
brick-like pattern. While often not a problem, such a brick-like pattern is undesirable when trying to build a structure having a natural appearance, such as when constructing a building using textured gray blocks (sometimes referred to as architectural units), or a soil retaining wall or other landscape structure using retaining wall blocks formed with a rock like, or stone-like appearance.

Summary of the Invention

One embodiment of the present invention provides a masonry block molded by a masonry block machine employing a mold assembly having a plurality of liner plates, at least one of which is moveable; the masonry block including a first transverse face, a second transverse face opposing the first transverse face, a first major face joining the first transverse face to the second transverse face, a second major face opposing the first major face and joining the first transverse face to the second transverse face, a first end face joining the first major face to the second major face, and a second end face opposing the first end face and joining the first major face to the second major face, wherein the first end face comprises a non-planar face configured to engage and overlap with a non-planar end face of a similar masonry block and is formed during a molding process through action of a moveable liner plate having a negative of the non-planar end face.

Brief Description of the Drawings

Figure 1 is a perspective view of one exemplary embodiment of a mold assembly having moveable liner plates according to the present invention.

Figure 2 is a perspective view of one exemplary embodiment of a gear drive assembly and moveable liner plate according to the present invention.

Figure 3A is a top view of gear drive assembly and moveable liner plate as illustrated in Figure 2.

Figure 3B is a side view of gear drive assembly and moveable liner plate as illustrated in Figure 2.
Figure 4A is a top view of the mold assembly of Figure 1 having the liner plates retracted.

Figure 4B is a top view of the mold assembly of Figure 1 having the liner plates extended.

Figure 5A illustrates a top view of one exemplary embodiment of a gear plate according to the present invention.

Figure 5B illustrates an end view of the gear plate illustrated by Figure 5A.

Figure 5C illustrates a bottom view of one exemplary embodiment of a gear head according to the present invention.

Figure 5D illustrates an end view of the gear head of Figure 5C.

Figure 6A is a top view of one exemplary embodiment of a gear track according to the present invention.

Figure 6B is a side view of the gear track of Figure 6A.

Figure 6C is an end view of the gear track of Figure 6A.

Figure 7 is a diagram illustrating the relationship between a gear track and gear plate according to the present invention.

Figure 8A is a top view illustrating the relationship between one exemplary embodiment of a gear head, gear plate, and gear track according to the present invention.

Figure 8B is a side view of the illustration of Figure 8A.

Figure 8C is an end view of the illustration of Figure 8A.

Figure 9A is a top view illustrating one exemplary embodiment of a gear plate being in a retracted position within a gear track according to the present invention.

Figure 9B is a top view illustrating one exemplary embodiment of a gear plate being in an extended position from a gear track according to the present invention.

Figure 10A is a diagram illustrating one exemplary embodiment of drive unit according to the present invention.
Figure 10B is a partial top view of the drive unit of the illustration of Figure 10A.

Figure 11A is a top view illustrating one exemplary embodiment of a mold assembly according to the present invention.

Figure 11B is a diagram illustrating one exemplary embodiment of a gear drive assembly according to the present invention.

Figure 12 is a perspective view illustrating a portion of one exemplary embodiment of a mold assembly according to the present invention.

Figure 13 is a perspective view illustrating one exemplary embodiment of a gear drive assembly according to the present invention.

Figure 14 is a top view illustrating a portion of one exemplary embodiment of a mold assembly and gear drive assembly according to the present invention.

Figure 15A is a top view illustrating a portion of one exemplary embodiment of a gear drive assembly employing a stabilizer assembly.

Figure 15B is a cross-sectional view of the gear drive assembly of Figure 15A.

Figure 15C is a cross-sectional view of the gear drive assembly of Figure 15A.

Figure 16 is a side view illustrating a portion of one exemplary embodiment of a gear drive assembly and moveable liner plate according to the present invention.

Figure 17 is a block diagram illustrating one exemplary embodiment of a mold assembly employing a control system according to the present invention.

Figure 18A is a top view illustrating a portion of one exemplary embodiment of gear drive assembly employing a screw drive system according to the present invention.

Figure 18B is a lateral cross-sectional view of the gear drive assembly of Figure 18A.

Figure 18C is a longitudinal cross-sectional view of the gear drive assembly of Figure 18A.
Figure 19 is a flow diagram illustrating one exemplary embodiment of a process for forming a concrete block employing a mold assembly according to the present invention.

Figure 20A is a front view illustrating generally a portion of one embodiment of a wall structure constructed of conventional masonry blocks.

Figure 20B is a perspective illustrating generally one example of a conventional masonry block.

Figure 21 is a perspective view of one embodiment of a masonry block according to the present invention.

Figure 22 is a perspective view of one embodiment of a masonry block according to the present invention.

Figure 23 is a perspective view of one embodiment of a masonry block according to the present invention.

Figure 24 is a perspective view of one embodiment of a masonry block according to the present invention.

Figure 25 is a front view illustrating generally a portion of one embodiment of a wall structure constructed of masonry blocks according to the present invention.

Figure 26A is top view illustrating an example implementation of a mold assembly for forming the masonry block of Figure 22.

Figure 26B is top view illustrating an example implementation of a mold assembly for forming the masonry block of Figure 22.

Figure 26C is sectional view of the mold assembly of Figure 26A.

Figure 26D is sectional view of the mold assembly of Figure 26B.

Figure 27 is a perspective view of one embodiment of a retaining wall block according to the present invention.

Figure 28 is a perspective view of one embodiment of a retaining wall block according to the present invention.

Figure 29 is a perspective view of one embodiment of a retaining wall block according to the present invention.
Figure 30 is a perspective view of one embodiment of a retaining wall block according to the present invention.

Figure 31 is a perspective view of one embodiment of a retaining wall block according to the present invention.

Figure 32 is a perspective view of one embodiment of a retaining wall block according to the present invention.

Figure 33 is a front view illustrating generally a portion of one embodiment of a wall structure constructed of retaining wall blocks according to the present invention.

Figure 34A is top view illustrating an example implementation of a mold assembly for forming the retaining wall block of Figure 27.

Figure 34B is top view illustrating an example implementation of a mold assembly for forming the retaining wall block of Figure 27.

Figure 34C is sectional view of the mold assembly of Figure 34A.

Figure 34D is sectional view of the mold assembly of Figure 34B.

Description of the Preferred Embodiments

In the following Detailed Description, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. In this regard, directional terminology, such as “top,” “bottom,” “front,” “back,” “leading,” “trailing,” etc., is used with reference to the orientation of the Figure(s) being described. Because components of embodiments of the present invention can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration and is in no way limiting. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims.
As described herein and illustrated by Figures 21-34D, masonry blocks and methods of making masonry blocks having at least one non-planar end face configured engage and overlap an end face of a similar masonry block are provided. Examples of mold and drive assemblies suitable to be configured for use with the present invention are described and illustrated below by Figures 1-19 and by U.S. Patent Application No.'s 10/629,460 filed July 29, 2003, 10/879,381 filed on June 29, 2004, and 11/036,147 filed on January 13, 2005, each of which is assigned to the same assignee as the present invention and incorporated by reference herein.

Figure 1 is a perspective view of one exemplary embodiment of a mold assembly 30 having moveable liner plates 32a, 32b, 32c and 32d according to the present invention. Mold assembly 30 includes a drive system assembly 31 having side-members 34a and 34b and cross-members 36a and 36b, respectively having an inner wall 38a, 38b, 40a, and 40b, and coupled to one another such that the inner surfaces form a mold box 42. In the illustrated embodiment, cross members 36a and 36b are bolted to side members 34a and 34b with bolts 37.

Moveable liner plates 32a, 32b, 32c, and 32d, respectively have a front surface 44a, 44b, 44c, and 44d configured so as to form a mold cavity 46. In the illustrated embodiment, each liner plate has an associated gear drive assembly located internally to an adjacent mold frame member. A portion of a gear drive assembly 50 corresponding to liner plate 32a and located internally to cross-member 36a is shown extending through side-member 34a. Each gear drive assembly is selectively coupled to its associated liner plate and configured to move the liner plate toward the interior of mold cavity 46 by applying a first force in a first direction parallel to the associated cross-member, and to move the liner plate away from the interior of mold cavity 46 by applying a second force in a direction opposite the first direction. Side members 34a and 34b and cross-members 36a and 36b each have a corresponding lubrication port that extends into the member and provides lubrication to the corresponds gear elements. For example, lubrication ports 48a and 48b. The gear drive assembly and moveable
liner plates according to the present invention are discussed in greater detail below.

In operation, mold assembly 30 is selectively coupled to a concrete block machine. For ease of illustrative purposes, however, the concrete block machine is not shown in Figure 1. In one embodiment, mold assembly 30 is mounted to the concrete block machine by bolting side members 34a and 34b of drive system assembly 31 to the concrete block machine. In one embodiment, mold assembly 30 further includes a head shoe assembly 52 having dimensions substantially equal to those of mold cavity 46. Head shoe assembly 52 is also configured to selectively couple to the concrete block machine.

Liner plates 32a through 32d are first extended a desired distance toward the interior of mold box 42 to form the desired mold cavity 46. A vibrating table on which a pallet 56 is positioned is then raised (as indicated by directional arrow 58) such that pallet 56 contacts and forms a bottom to mold cavity 46. In one embodiment, a core bar assembly (not shown) is positioned within mold cavity 46 to create voids within the finished block in accordance with design requirements of a particular block.

Mold cavity 46 is then filled with concrete from a moveable feedbox drawer. Head shoe assembly 52 is then lowered (as indicated by directional arrow 54) onto mold 46 and hydraulically or mechanically presses the concrete. Head shoe assembly 52 along with the vibrating table then simultaneously vibrate mold assembly 30, resulting in a high compression of the concrete within mold cavity 46. The high level of compression fills any voids within mold cavity 46 and causes the concrete to quickly reach a level of hardness that permits immediate removal of the finished block from mold cavity 46.

The finished block is removed by first retracting liner plates 32a through 32d. Head shoe assembly 52 and the vibrating table, along with pallet 56, are then lowered (in a direction opposite to that indicated by arrow 58), while mold assembly 30 remains stationary so that head shoe assembly 56 pushes the finished block out of mold cavity 46 onto pallet 52. When a lower edge of head shoe assembly 52 drops below a lower edge of mold assembly 30, the conveyer
system moves pallet 56 carrying the finished block away and a new pallet takes its place. The above process is repeated to create additional blocks.

By retracting liner plates 32a through 32b prior to removing the finished block from mold cavity 46, liner plates 32a through 32d experience less wear and, thus, have an increased operating life expectancy. Furthermore, moveable liner plates 32a through 32d also enables a concrete block to be molded in a vertical position relative to pallet 56, in lieu of the standard horizontal position, such that head shoe assembly 52 contacts what will be a "face" of the finished concrete block. A "face" is a surface of the block that will be potentially be exposed for viewing after installation in a wall or other structure.

Figure 2 is a perspective view 70 illustrating a moveable liner plate and corresponding gear drive assembly according to the present invention, such as moveable liner plate 32a and corresponding gear drive assembly 50. For illustrative purposes, side member 34a and cross-member 36 are not shown. Gear drive assembly 50 includes a first gear element 72 selectively coupled to liner plate 32a, a second gear element 74, a single rod-end double-acting pneumatic cylinder (cylinder) 76 coupled to second gear element 74 via a piston rod 78, and a gear track 80. Cylinder 76 includes an aperture 82 for accepting a pneumatic fitting. In one embodiment, cylinder 76 comprises a hydraulic cylinder. In one embodiment, cylinder 76 comprises a double rod-end dual-acting cylinder. In one embodiment, piston rod 78 is threadably coupled to second gear element 74.

In the embodiment of Figure 2, first gear element 72 and second gear element 74 are illustrated and hereinafter referred to as a gear plate 72 and second gear element 74, respectively. However, while illustrated as a gear plate and a cylindrical gear head, first gear element 72 and second gear element 74 can be of any suitable shape and dimension.

Gear plate 72 includes a plurality of angled channels on a first major surface 84 and is configured to slide in gear track 80. Gear track 80 slidably inserts into a gear slot (not shown) extending into cross member 36a from inner wall 40a. Cylindrical gear head 74 includes a plurality of angled channels on a
surface 86 adjacent to first major surface 84 of female gear plate 72, wherein the angled channels are tangential to a radius of cylindrical gear head 74 and configured to slidably mate and interlock with the angled channels of gear plate 72. Liner plate 32a includes guide posts 88a, 88b, 88c, and 88d extending from a rear surface 90. Each of the guide posts is configured to slidably insert into a corresponding guide hole (not shown) extending into cross member 36a from inner wall 40a. The gear slot and guide holes are discussed in greater detail below.

When cylinder 76 extends piston rod 78, cylindrical gear head 74 moves in a direction indicated by arrow 92 and, due to the interlocking angled channels, causes gear plate 72 and, thus, liner plate 32a to move toward the interior of mold 46 as indicated by arrow 94. It should be noted that, as illustrated, Figure 2 depicts piston rod 78 and cylindrical gear head 74 in an extended position. When cylinder 76 retracts piston rod 78, cylindrical gear head 74 moves in a direction indicated by arrow 96 causing gear plate 72 and liner plate 32 to move away from the interior of the mold as indicated by arrow 98. As liner plate 32a moves, either toward or away from the center of the mold, gear plate 72 slides in guide track 80 and guide posts 88a through 88d slide within their corresponding guide holes.

In one embodiment, a removable liner face 100 is selectively coupled to front surface 44a via fasteners 102a, 102b, 102c, and 102d extending through liner plate 32a. Removable liner face 100 is configured to provide a desired shape and/or provide a desired imprinted pattern, including text, on a block made in mold 46. In this regard, removable liner face 100 comprises a negative of the desired shape or pattern. In one embodiment, removable liner face 100 comprises a polyurethane material. In one embodiment, removable liner face 100 comprises a rubber material. In one embodiment, removable liner plate comprises a metal or metal alloy, such as steel or aluminum. In one embodiment, liner plate 32 further includes a heater mounted in a recess 104 on rear surface 90, wherein the heater aids in curing concrete within mold 46 to
reduce the occurrence of concrete sticking to front surface 44a and removable liner face 100.

Figure 3A is a top view 120 of gear drive assembly 50 and liner plate 32a, as indicated by directional arrow 106 in Figure 2. In the illustration, side members 34a and 34b, and cross member 36a are indicated dashed lines. Guide posts 88c and 88d are slidably inserted into guide holes 122c and 122d, respectively, which extend into cross member 36a from interior surface 40a. Guide holes 122a and 122b, corresponding respectively to guide posts 88a and 88b, are not shown but are located below and in-line with guide holes 122c and 122d. In one embodiment, guide hole bushings 124c and 124d are inserted into guide holes 122c and 122d, respectively, and slidably receive guide posts 88c and 88d. Guide hole bushings 124a and 124b are not shown, but are located below and in-line with guide hole bushings 124c and 124d. Gear track 80 is shown as being slidably inserted in a gear slot 126 extending through cross member 36a with gear plate 72 sliding in gear track 80. Gear plate 72 is indicated as being coupled to liner plate 32a by a plurality of fasteners 128 extending through liner plate 32a from front surface 44a.

A cylindrical gear shaft is indicated by dashed lines 134 as extending through side member 34a and into cross member 36a and intersecting, at least partially with gear slot 126. Cylindrical gear head 74, cylinder 76, and piston rod 78 are slidably inserted into gear shaft 134 with cylindrical gear head 74 being positioned over gear plate 72. The angled channels of cylindrical gear head 74 are shown as dashed lines 130 and are interlocking with the angled channels of gear plate 72 as indicated at 132.

Figure 3B is a side view 140 of gear drive assembly 50 and liner plate 32a, as indicated by directional arrow 108 in Figure 2. Liner plate 32a is indicated as being extended, at least partially, from cross member 36a. Correspondingly, guide posts 88a and 88d are indicated as partially extending from guide hole bushings 124a and 124d, respectively. In one embodiment, a pair of limit rings 142a and 142d are selectively coupled to guide posts 88a and 88, respectively, to limit an extension distance that liner plate 32a can be
5 extended from cross member 36a toward the interior of mold cavity 46. Limit rings 142b and 142c corresponding respectively to guide posts 88b and 88c are not shown, but are located behind and in-line with limit rings 142a and 142d. In the illustrated embodiment, the limit rings are indicated as being substantially at an end of the guide posts, thus allowing a substantially maximum extension distance from cross member 36a. However, the limit rings can be placed at other locations along the guide posts to thereby adjust the allowable extension distance.

Figure 4A and Figure 4B are top views 150 and 160, respectively, of mold assembly 30. Figure 4A illustrates liner plates 32a, 32b, 32c, and 32d in retracted positions. Liner faces 152, 154, and 154 correspond respectively to liner plates 32b, 32c, and 32d. Figure 4B illustrates liner plates 32a, 32b, 32c, and 32d, along with their corresponding liner faces 100, 152, 154, and 156 in an extended position.

Figure 5A is a top view 170 of gear plate 72. Gear plate 72 includes a plurality of angled channels 172 running across a top surface 174 of gear plate 72. Angled channels 172 form a corresponding plurality of linear “teeth” 176 having as a surface the top surface 174. Each angled channel 172 and each tooth 176 has a respective width 178 and 180. The angled channels run at an angle (θ) 182 from 0°, indicated at 186, across gear plate 72.

Figure 5B is an end view (“A”) 185 of gear plate 72, as indicated by directional arrow 184 in Figure 5A, further illustrating the plurality of angled channels 172 and linear teeth 176. Each angled channel 172 has a depth 192.

Figure 5C illustrates a view 200 of a flat surface 202 of cylindrical gear head 76. Cylindrical gear head 76 includes a plurality of angled channels 204 running across surface 202. Angled channels 204 form a corresponding plurality of linear teeth 206. The angled channels 204 and linear teeth 206 have widths 180 and 178, respectively, such that the width of linear teeth 206 substantially matches the width of angled channels 172 and the width of angled channels 204 substantially match the width of linear teeth 176. Angled channels 204 and teeth 206 run at angle (θ) 182 from 0°, indicated at 186, across surface 202.
Figure 5D is an end view 210 of cylindrical gear head 76, as indicated by directional arrow 208 in Figure 5C, further illustrating the plurality of angled channels 204 and linear teeth 206. Surface 202 is a flat surface tangential to a radius of cylindrical gear head 76. Each angled channel has a depth 192 from flat surface 202.

When cylindrical gear head 76 is “turned over” and placed across surface 174 of gear plate 72, linear teeth 206 of gear head 76 mate and interlock with angled channels 172 of gear plate 72, and linear teeth 176 of gear plate 72 mate and interlock with angled channels 204 of gear head 76 (See also Figure 2). When gear head 76 is forced in direction 92, linear teeth 206 of gear head 76 push against linear teeth 176 of gear plate 72 and force gear plate 72 to move in direction 94. Conversely, when gear head 76 is forced in direction 96, linear teeth 206 of gear head 76 push against linear teeth 176 of gear plate 72 and force gear plate 72 to move in direction 98.

In order for cylindrical gear head 76 to force gear plate 72 in directions 94 and 98, angle (θ) 182 must be greater than 0° and less than 90°. However, it is preferable that θ 182 be at least greater than 45°. When θ 182 is 45° or less, it takes more force for cylindrical gear head 74 moving in direction 92 to push gear plate 72 in direction 94 than it does for gear plate 72 being forced in direction 98 to push cylindrical gear head 74 in direction 96, such as when concrete in mold 46 is being compressed. The more θ 182 is increased above 45°, the greater the force that is required in direction 98 on gear plate 72 to move cylindrical gear head 74 in direction 96. In fact, at 90° gear plate 72 would be unable to move cylindrical gear head 74 in either direction 92 or 96, regardless of how much force was applied to gear plate 72 in direction 98. In effect, angle (θ) acts as a multiplier to a force provided to cylindrical gear head 74 by cylinder 76 via piston rod 78. When θ 182 is greater than 45°, an amount of force required to be applied to gear plate 72 in direction 98 in order to move cylindrical gear head 74 in direction 96 is greater than an amount of force required to be applied to cylindrical gear head 74 in direction 92 via piston rod.
78 in order to “hold” gear plate 72 in position (i.e., when concrete is being compressed in mold 46).

However, the more \( \Theta \) 182 is increased above 45\(^\circ\), the less distance gear plate 72, and thus corresponding liner plate 32a, will move in direction 94 when cylindrical gear head 74 is forced in direction 92. A preferred operational angle for \( \Theta \) 182 is approximately 70\(^\circ\). This angle represents roughly a balance, or compromise, between the length of travel of gear plate 72 and an increase in the level of force required to be applied in direction 98 on gear plate 72 to force gear head 74 in direction 96. Gear plate 72 and cylindrical gear head 74 and their corresponding angled channels 176 and 206 reduce the required psi rating of cylinder 76 necessary to maintain the position of liner plate 32a when concrete is being compressed in mold cavity 46 and also reduces the wear experienced by cylinder 76. Additionally, from the above discussion, it is evident that one method for controlling the travel distance of liner plate 32a is to control the angle (\( \Theta \)) 182 of the angled channels 176 and 206 respectively of gear plate 72 and cylindrical gear head 74.

Figure 6A is a top view 220 of gear track 80. Gear track 80 has a top surface 220, a first end surface 224, and a second end surface 226. A rectangular gear channel, indicated by dashed lines 228, having a first opening 230 and a second opening 232 extends through gear track 80. An arcuate channel 234, having a radius required to accommodate cylindrical gear head 76 extends across top surface 220 and forms a gear window 236 extending through top surface 222 into gear channel 228. Gear track 80 has a width 238 incrementally less than a width of gear opening 126 in side member 36a (see also Figure 3A).

Figure 6B is an end view 250 of gear track 80, as indicated by direction arrow 240 in Figure 6A, further illustrating gear channel 228 and arcuate channel 234. Gear track 80 has a depth 252 incrementally less than height of gear opening 126 in side member 36a (see Figure 3A). Figure 6B is a side view 260 of gear track 80 as indicated by directional arrow 242 in Figure 6A.

Figure 7 is a top view 270 illustrating the relationship between gear track 80 and gear plate 72. Gear plate 72 has a width 272 incrementally less than a
width 274 of gear track 80, such that gear plate 72 can be slidably inserted into
gear channel 228 via first opening 230. When gear plate 72 is inserted within
gear track 80, angled channels 172 and linear teeth 176 are exposed via gear
window 236.

Figure 8A is a top view 280 illustrating the relationship between gear
plate 72, cylindrical gear head 74, and gear track 80. Gear plate 72 is indicated
as being slidably inserted within guide track 80. Cylindrical gear head 74 is
indicated as being positioned within arcuate channel 234, with the angled
channels and linear teeth of cylindrical gear head 74 being slidably mated and
interlocked with the angled channels 172 and linear teeth 176 of gear plate 72.

When cylindrical gear head 74 is moved in direction 92 by extending piston rod
78, gear plate 72 extends outward from gear track 80 in direction 94 (See also
Figure 9B below). When cylindrical gear head 74 is moved in direction 96 by
retracting piston rod 78, gear plate 72 retracts into gear track 80 in direction 98
(See also Figure 9A below).

Figure 8B is a side view 290 of gear plate 72, cylindrical gear head 74, and guide track 80 as indicated by directional arrow 282 in Figure 8A.
Cylindrical gear head 74 is positioned such that surface 202 is located within
arcuate channel 234. Angled channels 204 and teeth 206 of cylindrical gear
head 74 extend through gear window 236 and interlock with angled channels
172 and linear teeth 176 of gear plate 72 located within gear channel 228.

Figure 8C is an end view 300 as indicated by directional arrow 284 in Figure 8A,
and further illustrates the relationship between gear plate 72, cylindrical gear
head 74, and guide track 80.

Figure 9A is top view 310 illustrating gear plate 72 being in a fully
retracted position within gear track 80, with liner plate 32a being retracted
against cross member 36a. For purposes of clarity, cylindrical gear head 74 is
not shown. Angled channels 172 and linear teeth 176 are visible through gear
window 236. Liner plate 32a is indicated as being coupled to gear plate 72 with
a plurality of fasteners 128 extending through liner plate 32a into gear plate 72.
In one embodiment, fasteners 128 threadably couple liner plate 32a to gear plate 72.

Figure 9B is a top view 320 illustrating gear plate 72 being extended, at least partially from gear track 80, with liner plate 32a being separated from cross member 36a. Again, cylindrical gear head 74 is not shown and angled channels 172 and linear teeth 176 are visible through gear window 236.

Figure 10A is a diagram 330 illustrating one exemplary embodiment of a gear drive assembly 332 according to the present invention. Gear drive assembly 332 includes cylindrical gear head 74, cylinder 76, piston rod 78, and a cylindrical sleeve 334. Cylindrical gear head 74 and piston rod 78 are configured to slidably insert into cylindrical sleeve 334. Cylinder 76 is threadably coupled to cylindrical sleeve 334 with an O-ring 336 making a seal. A window 338 along an axis of cylindrical sleeve 334 partially exposes angled channels 204 and linear teeth 206. A fitting 342, such as a pneumatic or hydraulic fitting, is indicated as being threadably coupled to aperture 82.

Cylinder 76 further includes an aperture 344, which is accessible through cross member 36a.

Gear drive assembly 332 is configured to slidably insert into cylindrical gear shaft 134 (indicated by dashed lines) so that window 338 intersects with gear slot 126 so that angled channels 204 and linear teeth 206 are exposed within gear slot 126. Gear track 80 and gear plate 72 (not shown) are first slidably inserted into gear slot 126, such that when gear drive assembly 332 is slidably inserted into cylindrical gear shaft 134 the angled channels 204 and linear teeth 206 of cylindrical gear head 74 slidably mate and interlock with the angled channels 172 and linear teeth 176 of gear plate 72.

In one embodiment, a key 340 is coupled to cylindrical gear head 74 and rides in a key slot 342 in cylindrical sleeve 334. Key 340 prevents cylindrical gear head 74 from rotating within cylindrical sleeve 334. Key 340 and key slot 342 together also control the maximum extension and retraction of cylindrical gear head 74 within cylindrical sleeve 334. Thus, in one embodiment, key 340 can be adjusted to control the extension distance of liner plate 32a toward the
interior of mold cavity 46. Figure 10A is a top view 350 of cylindrical shaft 334 as illustrated in Figure 10B, and further illustrates key 340 and key slot 342.

Figure 11A is a top view illustrating one exemplary embodiment of a mold assembly 360 according to the present invention for forming two concrete blocks. Mold assembly 360 includes a mold frame 361 having side members 34a and 34b and cross members 36a through 36c coupled to one another so as to form a pair of mold boxes 42a and 42b. Mold box 42a includes moveable liner plates 32a through 32d and corresponding removable liner faces 33a through 33d configured to form a mold cavity 46a. Mold box 42b includes moveable liner plates 32e through 32h and corresponding removable liner faces 33e through 33h configured to form a mold cavity 46b.

Each moveable liner plate has an associated gear drive assembly located internally to an adjacent mold frame member as indicated by 50a through 50h. Each moveable liner plate is illustrated in an extended position with a corresponding gear plate indicated by 72a through 72h. As described below, moveable liner plates 32c and 32e share gear drive assembly 50c/e, with gear plate 72e having its corresponding plurality of angled channels facing upward and gear plate 72c having its corresponding plurality of angled channels facing downward.

Figure 11B is diagram illustrating a gear drive assembly according to the present invention, such as gear drive assembly 50c/e. Figure 11B illustrates a view of gear drive assembly 50c/e as viewed from section A-A through cross-member 36c of Figure 11A. Gear drive assembly 50c/e includes a single cylindrical gear head 76c/e having angled channels 204c and 204e on opposing surfaces. Cylindrical gear head 76c/e fits into arcuate channels 234c and 234e of gear tracks 80c and 80d, such that angled channels 204c and 204e slidably interlock with angled channels 172c and 172e of gear plates 72c and 72e respectively.

Angled channels 172c and 204c, and 172e and 204e oppose one another and are configured such that when cylindrical gear head 76c/e is extended (e.g. out from Figure 11B) gear plate 72c moves in a direction 372 toward the interior
of mold cavity 46a and gear plate 72e moves in a direction 374 toward the interior of mold cavity 46b. Similarly, when cylindrical gear head 76c/e is retracted (e.g. into Figure 11B) gear plate 72c moves in a direction 376 away from the interior of mold cavity 46a and gear plate 72e moves in a direction 378 away from the interior of mold cavity 378. Again, cylindrical gear head 76c/e and gear plates 72c and 72e could be of any suitable shape.

Figure 12 is a perspective view illustrating a portion of one exemplary embodiment of a mold assembly 430 according to the present invention. Mold assembly includes moveable liner plates 432a through 432l for simultaneously molding multiple concrete blocks. Mold assembly 430 includes a drive system assembly 431 having a side members 434a and 434b, and cross members 436a and 436b. For illustrative purposes, side member 434a is indicated by dashed lines. Mold assembly 430 further includes division plates 437a through 437g.

Together, moveable liner plates 432a through 432l and division plates 437a through 437g form mold cavities 446a through 446f, with each mold cavity configured to form a concrete block. Thus, in the illustrated embodiment, mold assembly 430 is configured to simultaneously form six blocks. However, it should be apparent from the illustration that mold assembly 430 can be easily modified for simultaneously forming quantities of concrete blocks other than six.

In the illustrated embodiment, side members 434a and 434b each have a corresponding gear drive assembly for moving moveable liner plates 432a through 432f and 432g through 432l, respectively. For illustrative purposes, only gear drive assembly 450 associated with side member 434a and corresponding moveable liner plates 432a through 432g is shown. Gear drive assembly 450 includes first gear elements 472a through 472f selectively coupled to corresponding moveable liner plates 432a through 432f, respectively, and a second gear element 474. In the illustrated embodiment, first gear elements 472a through 472f and second gear element 474 are shown as being cylindrical in shape. However, any suitable shape can be employed.

Second gear element 474 is selectively coupled to a cylinder-piston (not shown) via a piston rod 478. In one embodiment, which is described in greater
detail below (see Figure 12), second gear element 474 is integral with the cylinder-piston so as to form a single component.

In the illustrated embodiment, each first gear element 472a through 472b further includes a plurality of substantially parallel angled channels 484 that slidably mesh and interlock with a plurality of substantially parallel angled channels 486 on second gear element 474. When second gear element 474 is moved in a direction indicated by arrow 492, each of the moveable liner plates 432a through 432f moves in a direction indicated by arrow 494. Similarly, when second gear element 474 is move in a direction indicated by arrow 496, each of the moveable liner plates 432a through 432f moves in a direction indicated by arrow 498.

In the illustrated embodiment, the angled channels 484 on each of the first gear elements 432a through 432f and the angled channels 486 are at a same angle. Thus, when second gear element 474 moves in direction 492 and 496, each moveable liner plate 432a through 432f moves a same distance in direction 494 and 498, respectively. In one embodiment, second gear element 474 includes a plurality of groups of substantially parallel angled channels with each group corresponding to a different one of the first gear elements 472a through 472f. In one embodiment, the angled channels of each group and its corresponding first gear element have a different angle such that each moveable liner plate 432a through 432f move a different distance in directions 494 and 498 in response to second gear element 474 being moved in direction 492 and 496, respectively.

Figure 13 is a perspective view illustrating a gear drive assembly 500 according to the present invention, and a corresponding moveable liner plate 502 and removable liner face 504. For illustrative purposes, a frame assembly including side members and cross members is not shown. Gear drive assembly 500 includes double rod-end, dual-acting pneumatic cylinder-piston 506 having a cylinder body 507, and a hollow piston rod 508 with a first rod-end 510 and a second rod-end 512. Gear drive assembly 500 further includes a pair of first gear elements 514a and 514b selectively coupled to moveable liner plate 502,
with each first gear element 514a and 514b having a plurality of substantially parallel angled channels 516a and 516b.

In the illustrated embodiment, cylinder body 507 of cylinder-piston 506 includes a plurality of substantially parallel angled channels 518 configured to mesh and slidably interlock with angled channels 516a and 516b. In one embodiment, cylinder body 507 is configured to slidably insert into and couple to a cylinder sleeve having angled channels 518.

In one embodiment, cylinder-piston 506 and piston rod 508 are located within a drive shaft of a frame member, such as drive shaft 134 of cross-member 36a, with rod-end 510 coupled to and extending through a frame member, such as side member 34b, and second rod-end 512 coupled to and extending through a frame member, such as side member 34a. First rod-end 510 and second rod-end 512 are configured to receive and provide compressed air to drive dual-acting cylinder-piston 506. With piston rod 508 being fixed to side members 34a and 34b via first and second rod-ends 512 and 510, cylinder-piston 506 travels along the axis of piston rod 508 in the directions as indicated by arrows 520 and 522 in response to compressed air received via first and second rod-ends 510 and 512.

When compressed air is received via second rod-end 512 and expelled via first rod-end 510, cylinder-piston 506 moves within a drive shaft, such as drive shaft 134, in direction 522 and causes first gear elements 514a and 516b and corresponding liner plate 502 and liner face 504 to move in a direction indicated by arrow 524. Conversely, when compressed air is received via first rod-end 510 and expelled via second rod-end 512, cylinder-piston 506 moves within a gear shaft, such as gear shaft 134, in direction 520 and causes first gear elements 514a and 516b and corresponding liner plate 502 and liner face 504 to move in a direction indicated by arrow 526.

In the illustrated embodiment, cylinder-piston 506 and first gear elements 514a and 514b are shown as being substantially cylindrical in shape. However, any suitable shape can be employed. Furthermore, in the illustrated embodiment, cylinder-piston 506 is a double rod-end dual-acting cylinder. In one embodiment, cylinder piston 506 is a single rod-end dual acting cylinder.
having only a single rod-end 510 coupled to a frame member, such as side member 34b. In such an embodiment, compressed air is provided to cylinder-piston via single rod-end 510 and a flexible pneumatic connection made to cylinder-piston 506 through side member 34a via gear shaft 134. Additionally, cylinder-piston 506 comprises a hydraulic cylinder.

Figure 14 is a top view of a portion of mold assembly 430 (as illustrated by Figure 12) having a drive assembly 550 according to one embodiment of the present invention. Drive assembly 550 includes first drive elements 572a to 572f that are selectively coupled to corresponding liner plates 432a to 432f via openings, such as opening 433, in side member 434a. Each of the first drive elements 572a to 572f if further coupled to a master bar 573. Drive assembly 550 further includes a double-rod-end hydraulic piston assembly 606 having a dual-acting cylinder 607 and a hollow piston rod 608 having a first rod-end 610 and a second rod-end 612. First and second rod-ends 610, 612 are stationary and are coupled to and extend through a removable housing 560 that is coupled to side member 434a and encloses drive assembly 550. First and second rod ends 610, 612 are each coupled to hydraulic fittings 620 that are configured to connect via lines 622a and 622b to an external hydraulic system 624 and to transfer hydraulic fluid to and from dual-acting cylinder 607 via hollow piston rod 608.

In one embodiment, as illustrated, first drive elements 572b and 572e include a plurality of substantially parallel angled channels 616 that slideably interlock with a plurality of substantially parallel angled channels 618 that form a second drive element. In one embodiment, as illustrated above by Figure 12, angled channels 618 are formed on dual-acting cylinder 607 of hydraulic piston assembly 606, such that dual-acting cylinder 607 forms the second drive element. In other embodiments, as will be described by Figures 15A – 15C below, the second drive element is separate from and operatively coupled to dual-acting cylinder 607.

When hydraulic fluid is transmitted into dual-acting cylinder 607 from second rod-end 612 via fitting 620 and hollow piston rod 608, hydraulic fluid is expelled from first rod-end 610, causing dual-acting cylinder 607 and angled
channels 618 to move along piston rod 608 toward second rod-end 612. As
dual-acting cylinder 607 moves toward second rod-end 612, angled channels 618
interact with angled channels 616 and drive first drive elements 572b and 572e,
and thus corresponding liner plates 432b and 432e, toward the interior of mold
cavities 446b and 446e, respectively. Furthermore, since each of the first drive
elements 572a through 572f is coupled to master bar 573, driving first gear
elements 572b and 572e toward the interiors of mold cavities 446b and 446e also
moves first drive elements 572a, 572c, 572d, and 572f and corresponding liner
plates 432a, 432c, 432d, and 432e toward the interiors of mold cavities 446a,
446c, 446d, and 446f, respectively. Conversely, transmitting hydraulic fluid into
dual-acting cylinder 607 from first rod-end 610 via fitting 620 and hollow-piston
rod 608 causes dual-acting cylinder 607 to move toward first rod-end 610, and
causes liner plates 432 to move away from the interiors of corresponding mold
cavities 446.

In one embodiment, drive assembly 550 further includes support shafts
626, such as support shafts 626a and 626b, which are coupled between
removable housing 560 and side member 434a and extend through master bar
573. As dual-acting cylinder 607 is moved by transmitting/expelling hydraulic
fluid from first and second rod-ends 610, 612, master bar 573 moves back and
forth along support shafts 626. Because they are coupled to static elements of
mold assembly 430, support shafts 626a and 626b provide support and rigidity to
liner plates 432, drive elements 572, and master bar 573 as they move toward
and away from mold cavities 446.

In one embodiment, drive assembly 550 further includes a pneumatic
fitting 628 configured to connect via line 630 to and external compressed air
system 632 and provide compressed air to housing 560. By receiving
compressed air via pneumatic fitting 628 to removable housing 560, the internal
air pressure of housing 560 is positive relative to the outside air pressure, such
that air is continuously “forced” out of housing 560 through any non-sealed
openings, such as openings 433 through which first drive elements 572 extend
through side member 434a. By maintaining a positive air pressure and forcing
air out through such non-sealed opening, the occurrence of dust and debris and
other unwanted contaminants from entering housing 560 and fouling drive
assembly 550 is reduced.

First and second rod ends 610, 612 are each coupled to hydraulic fittings
620 that are configured to connect via lines 622a and 622b to an external
hydraulic system 624 and to transfer hydraulic fluid to and from dual-acting
cylinder 607 via hollow piston rod 608.

Figure 15A is a top view illustrating a portion of one embodiment of
drive assembly 550 according to the present invention. Drive assembly 550
includes double-rod-end hydraulic piston assembly 606 comprising dual-acting
cylinder 607 and a hollow piston rod 608 with first and second rod-ends 610 and
612 being and coupled to and extending through removable housing 560.

As illustrated, dual-acting cylinder 607 is slideably-fitted inside a
machined opening 641 within a second gear element 640, with hollow piston rod
608 extending through removable end caps 642. In one embodiment, end caps
646 are threadably inserted into machined opening 641 such that end caps 646
butt against and secure dual-acting cylinder 607 so that dual-acting cylinder 607
is held stationary with respect to second drive element 640. Second drive
element 640 includes the plurality of substantially parallel angled channels 618,
in lieu of angled channels being an integral part of dual-acting cylinder 607.

With reference to Figure 14, angled channels 618 of second gear element 640 are
configured to slideably interlock with angled channels 616 of first gear elements
572b and 572e.

Second gear element 640 further includes a guide rail 644 that is
slideably coupled to linear bearing blocks 646 that are mounted to housing 560.

As described above with respect to Figure 14, transmitting and expelling
hydraulic fluid to and from dual-acting cylinder 607 via first and second rod-
ends 610, 612 causes dual-acting cylinder 607 to move along hollow piston-rod
608. Since dual-acting cylinder 607 is “locked” in place within machined shaft
641 of second gear element 640 by end caps 642, second gear element 640
moves along hollow piston-rod 608 together with dual-acting cylinder 607. As
second drive element 640 moves along hollow piston-rod 608, linear bearing blocks 646 guide and secure guide rail 644, thereby guiding and securing second drive element 640 and reducing undesirable motion in second drive element 640 that is perpendicular to hollow piston rod 608.

Figure 15B is a lateral cross-sectional view A-A of the portion of drive assembly 550 illustrated by Figure 15A. Guide rail 644 is slideably fitted into a linear bearing track 650 and rides on bearings 652 as second drive element 640 is moved along piston rod 608 by dual-acting cylinder 607. In one embodiment, linear bearing block 646b is coupled to housing 560 via bolts 648.

Figure 15C is a longitudinal cross-sectional view B-B of the portion of drive assembly 550 of Figure 15A, and illustrates dual-acting cylinder 607 as being secured within shaft 641 of drive element 640 by end caps 642a and 642b. In one embodiment, end caps 642a and 642b are threadably inserted into the ends of second drive element 640 so as to butt against each end of dual-acting cylinder 607. Hollow piston rod 608 extends through end caps 642a and 642b and has first and second rod ends 610 and 612 coupled to and extending through housing 560. A divider 654 is coupled to piston rod 608 and divides dual-acting cylinder 607 into a first chamber 656 and a second chamber 658. A first port 660 and a second port 662 allow hydraulic fluid to be pumped into and expelled from first chamber 656 and second chamber 658 via first and second rod ends 610 and 612 and associated hydraulic fittings 620, respectively.

When hydraulic fluid is pumped into first chamber 656 via first rod-end 610 and first port 660, dual-acting cylinder 607 moves along hollow piston rod 608 toward first rod-end 610 and hydraulic fluid is expelled from second chamber 658 via second port 662 and second rod-end 612. Since dual-acting cylinder 607 is secured within shaft 641 by end caps 642a and 642b, second drive element 640 and, thus, angled channels 618 move toward first rod-end 610. Similarly, when hydraulic fluid is pumped into second chamber 658 via second rod-end 612 and second port 662, dual-acting cylinder 607 moves along hollow piston rod 608 toward second rod-end 612 and hydraulic fluid is expelled from first chamber 656 via first port 660 and first rod-end 610.
Figure 16 is a side view of a portion of drive assembly 550 as shown by Figure 14 and illustrates a typical liner plate, such as liner plate 432a, and corresponding removable liner face 400. Liner plate 432a is coupled to second drive element 572a via a bolted connection 670 and, in-turn, drive element 572a is coupled to master bar 573 via a bolted connection 672. A lower portion of liner face 400 is coupled to liner plate 432a via a bolted connection 674. In one embodiment, as illustrated, liner plate 432a includes a raised "rib" 676 that runs the length of and along an upper edge of liner plate 432a. A channel 678 in liner face 400 overlaps and interlocks with raised rib 676 to form a "boltless" connection between liner plate 432a and an upper portion of liner face 400.

Such an interlocking connection securely couples the upper portion of liner face 400 to liner plate 432 in an area of liner face 400 that would otherwise be too narrow to allow use of a bolted connection between liner face 400 and liner plate 432a without the bolt being visible on the surface of liner face 400 that faces mold cavity 446a.

In one embodiment, liner plate 432 includes a heater 680 configured to maintain the temperature of corresponding liner face 400 at a desired temperature to prevent concrete in corresponding mold cavity 446 sticking to a surface of liner face 400 during a concrete curing process. In one embodiment, heater 680 comprises an electric heater.

Figure 17 is a block diagram illustrating one embodiment of a mold assembly according to the present invention, such as mold assembly 430 of Figure 14, further including a controller 700 configured to coordinate the movement of moveable liner plates, such as liner plates 432, with operations of concrete block machine 702 by controlling the operation of the drive assembly, such as drive assembly 550. In one embodiment, as illustrated, controller 700 comprises a programmable logic controller (PLC).

As described above with respect to Figure 1, mold assembly 430 is selectively coupled, generally via a plurality of bolted connections, to concrete block machine 702. In operation, concrete block machine 702 first places pallet 56 below mold box assembly 430. A concrete feedbox 704 then fills mold
cavities, such as mold cavities 446, of assembly 430 with concrete. Head shoe assembly 52 is then lowered onto mold assembly 430 and hydraulically or mechanically compresses the concrete in mold cavities 446 and, together with a vibrating table on which pallet 56 is positioned, simultaneously vibrates mold assembly 430. After the compression and vibration is complete, head shoe assembly 52 and pallet 56 are lowered relative to mold cavities 446 so that the formed concrete blocks are expelled from mold cavities 446 onto pallet 56. Head shoe assembly 52 is then raised and a new pallet 56 is moved into position below mold cavities 446. The above process is continuously repeated, with each such repetition commonly referred to as a cycle. With specific reference to mold assembly 430, each such cycle produces six concrete blocks.

PLC 700 is configured to coordinate the extension and retraction of liner plates 432 into and out of mold cavities 446 with the operations of concrete block machine 702 as described above. At the start of a cycle, liner plates 432 are fully retracted from mold cavities 446. In one embodiment, with reference to Figure 14, drive assembly 550 includes a pair of sensors, such as proximity switches 706a and 706b to monitor the position of master bar 573 and, thus, the positions of corresponding moveable liner plates 432 coupled to master bar 573. As illustrated in Figure 14, proximity switches 706a and 706b are respectively configured to detect when liner plates 432 are in an extended position and a retracted position with respect to mold cavities 446.

In one embodiment, after pallet 56 has been positioned beneath mold assembly 430, PLC 700 receives a signal 708 from concrete block machine 702 indicating that concrete feedbox 704 is ready to deliver concrete to mold cavities 446. PLC 700 checks the position of moveable liners 432 based on signals 710a and 710b received respectively from proximity switches 706a and 706b. With liner plates 432 in a retracted position, PLC 700 provides a liner extension signal 712 to hydraulic system 624.

In response to liner extension signal 712, hydraulic system 624 begins pumping hydraulic fluid via path 622b to second rod-end 612 of piston assembly 606 and begins receiving hydraulic fluid from first rod-end 610 via path 622a,
thereby causing dual-acting cylinder 607 to begin moving liner plates 432 toward the interiors of mold cavities 446. When proximity switch 706a detects master bar 573, proximity switch 706a provides signal 710a to PLC 700 indicating that liner plates 432 have reached the desired extended position. In response to signal 710a, PLC 700 instructs hydraulic system 624 via signal 712 to stop pumping hydraulic fluid to piston assembly 606 and provides a signal 714 to concrete block machine 702 indicating that liner plates 432 are extended.

In response to signal 714, concrete feedback 704 fills mold cavities 446 with concrete and head shoe assembly 52 is lowered onto mold assembly 430. After the compression and vibrating of the concrete is complete, concrete block machine 702 provides a signal 716 indicating that the formed concrete blocks are ready to be expelled from mold cavities 446. In response to signal 716, PLC 700 provides a liner retraction signal 718 to hydraulic system 624.

In response to liner retraction signal 718, hydraulic system 624 begins pumping hydraulic fluid via path 622a to first rod-end 610 via path 622 and begins receiving hydraulic fluid via path 622b from second rod-end 612, thereby causing dual-acting cylinder 607 to begin moving liner plates 432 away from the interiors of mold cavities 446. When proximity switch 706b detects master bar 573, proximity switch 706b provides signal 710b to PLC 700 indicating that liner plates 432 have reached a desired retracted position. In response to signal 710b, PLC 700 instructs hydraulic system 624 via signal 718 to stop pumping hydraulic fluid to piston assembly 606 and provides a signal 720 to concrete block machine 702 indicating that liner plates 432 are retracted.

In response to signal 720, head shoe assembly 52 and pallet 56 eject the formed concrete blocks from mold cavities 446. Concrete block machine 702 then retracts head shoe assembly 52 and positions a new pallet 56 below mold assembly 430. The above process is then repeated for the next cycle.

In one embodiment, PLC 700 is further configured to control the supply of compressed air to mold assembly 430. In one embodiment, PLC 700 provides a status signal 722 to compressed air system 630 indicative of when concrete block machine 702 and mold assembly 430 are in operation and forming
concrete blocks. When in operation, compressed air system 632 provides compressed air via line 630 and pneumatic fitting 628 to housing 560 of mold assembly 420 to reduce the potential for dirt/dust and other debris from entering drive assembly 550. When not in operation, compressed air system 632 does not provide compressed air to mold assembly 430.

Although the above description of controller 700 is in regard to controlling a drive assembly employing only a single piston assembly, such as piston assembly 606 of drive assembly 500, controller 700 can be adapted to control drive assemblies employing multiple piston assemblies and employing multiple pairs of proximity switches, such as proximity switches 706a and 706b. In such instances, hydraulic system 624 would be coupled to each piston assembly via a pair of hydraulic lines, such as lines 622a and 622b. Additionally, PLC 700 would receive multiple position signals and would respectively allow mold cavities to be filled with concrete and formed blocks to be ejected only when each applicable proximity switch indicates that all moveable liner plates are at their extended position and each applicable proximity switch indicates that all moveable liner plates are at their retracted position.

Figures 18A through 18C illustrate portions of an alternate embodiment of drive assembly 550 as illustrated by Figures 15A through 15C. Figure 18A is top view of second gear element 640, wherein second gear element 640 is driven by a screw drive system 806 in lieu of a piston assembly, such as piston assembly 606. Screw drive system 806 includes a threaded screw 808, such as an Acme or Ball style screw, and an electric motor 810. Threaded screw 808 is threaded through a corresponding threaded shaft 812 extending lengthwise through second gear element 640. Threaded screw 808 is coupled at a first end to a first bearing assembly 814a and is coupled at a second end to motor 810 via a second bearing assembly 814b. Motor 810 is selectively coupled via motor mounts 824 to housing 560 and/or to the side/cross members, such as cross member 434a, of the mold assembly.
In a fashion similar to that described by Figure 15A, second gear element 640 includes the plurality of angled channels 618 which slideably interlock and mesh with angled channels 616 of first gear elements 572b and 572e, as illustrated by Figure 14. Since second gear element 640 is coupled to linear bearing blocks 646, when motor 810 is driven to rotate threaded screw 808 in a counter-clockwise direction 816, second gear element 640 is driven in a direction 818 along linear bearing track 650. As second gear element 640 moves in direction 818, angled channels 618 interact with angled channels 616 and extend liner plates, such as liner plates 432a through 432f illustrated by Figures 12 and 14, toward the interior of mold cavities 446a through 446f.

When motor 810 is driven to rotate threaded screw 808 in a clockwise direction 820, second gear element 640 is driven in a direction 822 along linear bearing track 650. As second gear element 640 moves in direction 822, angled channels 618 interact with angled channels 616 and retract liner plates, such as liner plates 432a through 432f illustrated by Figures 12 and 14, away from the interior of mold cavities 446a through 446f. In one embodiment, the distance the liner plates are extended and retracted toward and away from the interior of the mold cavities is controlled based on the pair of proximity switches 706a and 706b, as illustrated by Figure 14. In an alternate embodiment, travel distance of the liner plates is controlled based on the number of revolutions of threaded screw 808 is driven by motor 810.

Figures 18B and 18C respectively illustrate lateral and longitudinal cross-sectional views A-A and B-B of drive assembly 550 as illustrated by Figure 18A. Although illustrated as being located external to housing 560, in alternate embodiments, motor 810 is mounted within housing 560.

As described above, concrete blocks, also referred to broadly as concrete masonry units (CMUs), encompass a wide variety of types of blocks such as, for example, patio blocks, pavers, light weight blocks, gray blocks, architectural units, and retaining wall blocks. The terms concrete block, masonry block, and concrete masonry unit are employed interchangeably herein, and are intended to include all types of concrete masonry units suitable to be formed by the
assemblies, systems, and methods of the present invention. Furthermore, although described herein primarily as comprising and employing concrete, dry-cast concrete, or other concrete mixtures, the systems, methods, and concrete masonry units of the present invention are not limited to such materials, and are intended to encompass the use of any material suitable for the formation of such blocks.

Figure 19 is flow diagram illustrating one exemplary embodiment of a process 850 for forming a concrete block employing a mold assembly according to the present invention, with reference to mold assembly 30 as illustrated by Figure 1. Process 850 begins at 852, where mold assembly 30 is bolted, such as via side members 34a and 34b, to a concrete block machine. For ease of illustration, the concrete block machine is not shown in Figure 1. Examples of concrete block machines for which mold assembly is adapted for use include models manufactured by Columbia and Besser. In one embodiment, installation of mold assembly 30 in the concrete block machine at 852 further includes installation of a core bar assembly (not shown in Figure 1, but known to those skilled in the art), which is positioned within mold cavity 46 to create voids within the formed block in accordance with design requirements of a particular block. In one embodiment, mold assembly 30 further includes head shoe assembly 52, which is also bolted to the concrete block machine at 852.

At 854, one or more liner plates, such as liner plates 32a through 32d, are extended a desired distance to from a mold cavity 46 having a negative of a desired shape of the concrete block to be formed. As will be described in further detail below, the number of moveable liner plates may vary depending on the particular implementation of mold assembly 30 and the type of concrete block to be formed. At 856, after the one or more liners plates have been extended, the concrete block machine raises a vibrating table on which pallet 56 is located such that pallet 56 contacts mold assembly 30 and forms a bottom to mold cavity 46.

At 858, the concrete block machine moves a feedbox drawer (not illustrated in Figure 1) into position above the open top of mold cavity 46 and
fills mold cavity 46 with a desired concrete mixture. After mold cavity 46 has
been filled with concrete, the feedbox drawer is retracted, and concrete block
machine, at 860, lowers head shoe assembly 52 onto mold cavity 46. Head shoe
assembly 52 configured to match the dimensions and other unique
configurations of each mold cavity, such as mold cavity 46.

At 862, the concrete block machine then compresses (e.g. hydraulically
or mechanically) the concrete while simultaneously vibrating mold assembly 30
via the vibrating table on which pallet 56 is positioned. The compression and
vibration together causes concrete to substantially fill any voids within mold
cavity 46 and causes the concrete quickly reach a level of hardness ("pre-cure")
that permits removal of the formed concrete block from mold cavity 46.

At step 864, the one or more moveable liner plates 32 are retracted away
from the interior of mold cavity 46. After the liner plates 32 are retracted, the
concrete block machine removes the formed concrete block from mold cavity 46
by moving head shoe assembly 52 along with the vibrating table and pallet 56
downward while mold assembly 30 remains stationary. The head shoe
assembly, vibrating table, and pallet 56 are lower until a lower edge of head shoe
assembly 52 drops below a lower edge of mold cavity 46 and the formed block is
ejected from mold cavity 46 onto pallet 56. A conveyor system then moves
pallet 56 carrying the formed block away from the concrete block machine to an
oven where the formed block is cured. Head shoe assembly 56 is raised to the
original start position at 868, and process 850 returns to 854 where the above
described process is repeated to create additional concrete blocks.

Figure 21 is a perspective view of one embodiment of a masonry block
900 according to the present invention. Masonry block 900 includes a first
major face 902, a second major face 904, a first transverse face 906, a second
transverse face 908, and first and second end faces 910 and 912. In one
embodiment, first and second major faces 902 and 904 respectively comprise
front and rear faces, and first and second transverse faces 906 and 908 comprise
top and bottom faces of masonry block 900. In one embodiment, as illustrated, a
pair of apertures or hollow cores 914 extend through masonry block 900 from
first transverse face 906 to second transverse face 908. Masonry block 900 is sometimes referred to as a gray block.

In one embodiment, as illustrated by Figure 21, first major face 902 includes a desired three-dimensional texture or pattern which is imparted to first major face 902 during a block molding process by a moveable liner plate, such as moveable liner plate 32b (see Figure 1) which includes a negative of the desired three-dimensional pattern. In one embodiment, both first major face 902 and second major face 904 include a three-dimensional texture or pattern imparted by corresponding moveable liner plates. The desired three-dimensional texture or pattern can be nearly any texture or pattern, such as, for example, natural stone(s), stones stacked in layers, multiple stones which have been mortared together, text, and any number of desired graphics or designs. It is noted that gray blocks having one or more textured surfaces are sometimes referred to as architectural units.

In accordance with the present invention, at least one of the first and second end faces 910 and 912 of masonry block 900 is non-planar and configured overlap with a non-planar end face of a similar masonry block to which it is adjacent when arranged in courses to form a wall or other structure (see Figure 25 below). In one embodiment, as illustrated by Figure 21, first end face 910 is a non-planar and formed by a flange 916 which extends between first and second major faces 902 and 904 along an edge shared with first transverse face 906. Flange 916, in-turn, defines a notch 918 which extends substantially parallel to flange 916 between first and second major surface 902 and 904 along an edge shared with second transverse face 908. In one embodiment, as will be described in greater detail below by Figures 26A-26D, flange 916 is formed through action of a moveable liner plate in cooperation with a pallet.

Masonry block 900 has a width (W) 920, a depth (D) 922, and a height (H) 924. Flange 916 has a height (H1) 926 and notch 918 has a height (H2) 928. Flange 916 and notch 918 have a width (W1) 930. In one exemplary embodiment, H1 926 and H2 928 are substantially equal to one-half H 924 of masonry block 900. Masonry block 900 can be formed with a plurality of
dimensions, including standard dimensions such as, for example, 4"(H) x 12"(D) x 9"(W) and 8"(H) x 12"(D) x 18"(W). Additionally, although illustrated as having a pair of hollow cores 914, masonry block 900 may include more or fewer than two hollow cores. For example, in one embodiment, masonry block 900 may be of solid construction and include no hollow cores.

Figure 22 is a perspective view illustrating generally one embodiment of a masonry block 950 according to the present invention. Masonry block 950 is similar to masonry block 900 of Figure 21, except that, in addition to first end face 910 being non-planar, second end face 912 is also non-planar in shape and configured to overlap with a non-planar end face a similar masonry block to which it is adjacent when arranged in courses to form a wall or other structure (see Figure 25 below).

In one embodiment, as illustrated by Figure 22, second end face 912 is a non-planar and formed by a flange 952 which extends between first and second major faces 902 and 904 along an edge shared with second transverse face 908. Flange 952, in-turn, defines a notch 954 which extends substantially parallel to flange 952 between first and second major surfaces 902 and 904 along an edge shared with first transverse face 906. Flange 952 has a height (H3) 956 and notch 954 has a height (H4) 958. Flange 952 and notch 952 have a width (W2) 960. In one exemplary embodiment, H3 956 and H4 958 are substantially equal to one-half H 924 and W2 960 is substantially equal to W1 930 of masonry block 900 of Figure 21.

Figure 23 is a perspective view illustrating generally one embodiment of a masonry block 970 according to the present invention. Masonry block 970 is similar to masonry block 900 of Figure 21, except that, in addition to first end face 910 being non-planar, second end face 912 is also non-planar in shape and configured to overlap with a non-planar end face a similar masonry block to which it is adjacent when arranged in courses to form a wall or other structure (see Figure 25 below).

In one embodiment, as illustrated by Figure 23, second end face 912 is a non-planar and formed by a flange 972 which extends between first and second
major faces 902 and 904 along an edge shared with first transverse face 906. Flange 972, in-turn, defines a notch 974 which extends substantially parallel to flange 972 between first and second major surfaces 902 and 904 along an edge shared with second transverse face 908. Flange 972 has a height (H5) 976 and notch 974 has a height (H6) 978. Flange 972 and notch 974 have a width (W3) 980. In one exemplary embodiment, H5 976 and H6 978 are substantially equal to one-half H 924 and W2 960 is substantially equal to W1 930 of masonry block 900 of Figure 21.

Although non-planar end face 910 and 912 are illustrated above by blocks 900, 950, and 970 of Figures 21-23 as comprising a rectangular notch and a rectangular flange, such as flange 916 and notch 918 of block 900 of Figure 21, the non-planar end faces are not limited to such rectangular configurations. For example, Figure 24 is a perspective view illustrating one embodiment of a masonry block 990 according to the present invention where non-planar end face 910 is formed by a flange 992 which transitions to a notch 994 via an angled element 996, where flange 992, notch 994, and angled element 996 are formed through action of a moveable liner plate as part of a block formation process.

Figure 25 is an illustrative example of a portion of a wall structure 1000 constructed using gray blocks 900, 950 and 970 of Figures 21-23 having at least one non-planar end face and configured to overlap an end face of a similar block in accordance with the present invention. As illustrated, the pattern of joints formed by blocks 900, 950, and 970 is less grid-like than that formed by conventional gray blocks 890 as illustrated by Figure 20A.

Figures 26A-26D are simplified illustrations of one implementation of mold assembly 30 and a block formation process for forming masonry block 950 of Figure 22. Mold assembly 30 is similar to that illustrated above by Figure 1 and includes side members 34a, 34b, cross-members 36a, 36b, stationary liner plate 32b, and moveable liner plates 32a, 32c, and 32d. Drive assemblies 31a, 31c, and 31d are respectively coupled to and configured to extend and retract moveable liner plates 32a, 32c, and 32d toward and away from the interior of
mold cavity 46. Liner faces 100a, 100c, and 100d are respectively coupled to moveable liner plates 32a, 32, and 32d. Liner face 100a comprises a negative of flange 952 and notch 954 of end face 912, liner face 100c comprises a negative of flange 916 and notch 918 of end face 910, and liner face 100d comprises a negative of the desired three-dimensional texture or pattern to be imprinted on major face 902 of masonry block 950 (see Figure 22). A core bar assembly 1002 is placed within mold cavity 46 with support (not shown) extending from side members 34a, 34b and cross-members 36a, 36b.

Figures 26A is top view of mold assembly 30 illustrating moveable liner plates 32a, 32c, and 32d in their retracted positions. Figure 26B is a top view of mold assembly 30 illustrating moveable liner plates 32a, 32c, and 32d in their extended positions at which point concrete is ready to be introduced in to mold cavity 46. Figures 26C and 26D illustrate simplified cross-sectional views of mold assembly through along section line A-A (see Figures 26A and 26B), and further illustrate head shoe assembly 52 and pallet 56. Figures 26C and 26D respectively illustrate moveable liner plates 32a and 32c in their retracted and extended positions. Figure 26D further illustrates head shoe assembly 52 positioned within the top of mold cavity 46 after concrete has been introduced. For ease of illustration, core bar assembly 2002 in not shown in Figures 26C and 26D.

Although illustrated herein in terms of gray blocks, overlapping non-planar end faces which, in-turn, provide overlapping major or front faces can also be employed with other types of masonry blocks as well, such as retaining wall blocks, for example. Figures 27 – 32 illustrate examples of retaining wall blocks employing at least one non-planar end face configured to overlap a non-planar end face of a similar retaining wall block.

Figure 27 is a perspective view of one embodiment of a retaining wall block 1030 according to the present invention. Retaining wall block 1030 includes a front face 1032, a rear face 1034, a top face 1036, a bottom face 1038, and first and second end faces 1040 and 1042. In one embodiment, as illustrated by Figure 27, front face 1032 includes a desired three-dimensional texture or
pattern which is imparted to first major face 1032 during a block molding process by a moveable liner plate, such as moveable liner plate 32b (see Figure 1) which includes a negative of the desired three-dimensional pattern. The desired three-dimensional texture or pattern can be nearly any texture or pattern, such as, for example, natural stone(s), stones stacked in layers, multiple stones which have been mortared together, text, and any number of desired graphics or designs.

In accordance with the present invention, at least one of the first and second end faces 1040 and 1042 of masonry block 1030 is non-planar and configured overlap with a non-planar end face of a similar masonry block to which it is adjacent when arranged in courses to form a wall or other structure (see Figure 33 below). In one embodiment, as illustrated by Figure 21, first end face 1040 is a non-planar and formed by a flange 1044 which extends between front and rear major faces 10322 and 1034 along an edge shared with bottom face 1038. Flange 1044, in-turn, defines a notch 1046 which extends substantially parallel to flange 1044 between front and rear faces 1032 and 1034 along an edge shared with top face 1036. In one embodiment, as will be described in greater detail below by Figures 33A-33D, flange 1044 is formed through action of a moveable liner plate in cooperation with a pallet.

Front face 1032 has a width (Wf) 1048 and rear face 1034 had a width (Wr) 1050. In one embodiment, as illustrated, Wr 1050 is less than Wf 1048 such that first and second side faces 1040 and 1042 are inwardly angled from front face 1032 to rear face 1034 at an angle (θ) 1052. Retaining wall block 1030 has a height (H) 1054 and a depth (D) 1056. Flange 1044 has a height (H1) 1058 and notch 1046 has a height (H2) 1060, with each having a width (W1) 1062. In one exemplary embodiment, H1 1058 and H2 1060 are substantially equal to one-half H 1054 of retaining wall block 1030. Retaining wall block 1030 can be formed with a plurality of dimensions, including standard dimensions such as, for example, 4"(H) x 12"(D) x 9"(W) and 8"(H) x 12"(D) x 18"(W).
In one embodiment, as illustrated, retaining wall block 1030 includes a set-back flange 1064 extending from bottom face 1038 along the edge formed with rear face 1034. Retaining wall blocks, such as retaining wall block 1030, are generally stacked in courses to form a retaining wall (see Figure 33). Set-back flange 1064 is adapted to abut against a rear face of a similar block in a course of block below retaining wall block 1030 so as to position front face 1032 a desired set-back distance from the front face(s) of blocks in the course below. In one embodiment, as is illustrated in greater detail below by Figure 33C, set-back flange 1064 is formed through action of a moveable shoe assembly during formation of the block. Additionally, though not illustrated, retaining wall block 1030 may be formed with one or more hollow cores, similar to hollow cores 914 of masonry block 900 of Figure 21.

Figure 28 is a perspective view illustrating generally one embodiment of a masonry block 1070 according to the present invention. Masonry block 1070 is similar to masonry block 1030 of Figure 27, except that second end face 1042 is non-planar in shape and configured to overlap with a non-planar end face a similar masonry block to which it is adjacent when arranged in courses to form a wall or other structure (see Figure 33 below).

In one embodiment, as illustrated by Figure 28, second end face 1042 is a non-planar and formed by a flange 1072 which extends between front and rear faces 1032 and 1034 along an edge shared with top face 1036. Flange 1072, in-turn, defines a notch 1074 which extends substantially parallel to flange 1072 between front and rear faces 1032 and 1034 along an edge shared with bottom face 1038. Flange 1072 has a height (H3) 1076 and notch 1074 has a height (H4) 1078. Flange 1072 and notch 1074 have a width (W2) 1080. In one exemplary embodiment, H3 1076 and H4 1078 are substantially equal to one-half H 1054 and W2 1080 is substantially equal to W1 1062 of retaining wall block 1030 of Figure 27.

Figure 29 is a perspective view illustrating generally one embodiment of a masonry block 1090 according to the present invention which comprises a combination of retaining wall blocks 1030 and 1070 of Figures 27 and 28. As
such, first end face 1040 includes flange 1044 and notch 1046 and second end face 1042 includes flange 1072 and notch 1074, so that both first and second end faces are configured to overlap non-planar faces of similar masonry blocks to which it is adjacent when arranged in courses to form a wall or other structure (see Figure 33 below).

Figure 30 is a perspective view illustrating generally one embodiment of a masonry block 1100 according to the present invention. Masonry block 1100 is similar to masonry block 1030 of Figure 27, except that non-planar end face 1040 is formed by a flange 1102 which extends between front and rear faces 1032 and 1034 along an edge shared with top face 1036. Similarly, flange 1102 defines a notch 1104 which extends substantially parallel to flange 1102 between front and rear faces 1032 and 1034 along and edge shared with bottom face 1038. Flange 1102 has a height (H5) 1106 and notch 1104 has a height (H6) 1108. Flange 1102 and notch 1104 have a width (W3) 1110. In one exemplary embodiment, H5 1106 and H6 1108 are substantially equal to one-half H 1054 and W3 1110 is substantially equal to W1 1062 of retaining wall block 1030 of Figure 27.

Figure 31 is a perspective view illustrating generally one embodiment of a masonry block 1120 according to the present invention. Masonry block 1120 is similar to masonry block 1030 of Figure 27, except that second end face 1042 is non-planar in shape and configured to overlap with a non-planar end face a similar masonry block to which it is adjacent when arranged in courses to form a wall or other structure (see Figure 33 below).

In one embodiment, as illustrated by Figure 31, second end face 1042 is a non-planar and formed by a flange 1122 which extends between front and rear faces 1032 and 1034 along an edge shared with bottom face 1038. Flange 1122, in-turn, defines a notch 1124 which extends substantially parallel to flange 1122 between front and rear faces 1032 and 1034 along an edge shared with top face 1036. Flange 1122 has a height (H7) 1126 and notch 1124 has a height (H8) 1128. Flange 1122 and notch 1124 have a width (W4) 1130. In one exemplary embodiment, H7 1126 and H8 1128 are substantially equal to one-half H 1054
and W4 1130 is substantially equal to W1 1062 of retaining wall block 1030 of Figure 27.

Figure 32 is a perspective view illustrating generally one embodiment of a masonry block 1140 according to the present invention which comprises a combination of retaining wall blocks 1100 and 1120 of Figures 30 and 31. As such, first end face 1040 includes flange 1102 and notch 1104 and second end face 1042 includes flange 1122 and notch 1124, so that both first and second end faces are configured to overlap non-planar faces of similar masonry blocks to which it is adjacent when arranged in courses to form a wall or other structure (see Figure 33 below).

Figure 23 is an illustrative example of a portion of a wall structure 1150 constructed using gray blocks 1030, 1070, 1090, 1100, 1120, and 1140 of Figures 27-32 having at least one non-planar end face and configured to overlap an end face of a similar block in accordance with the present invention. As illustrated, the pattern of joints formed by retaining wall blocks 1030, 1070, 1090, 1100, 1120, and 1140 is less grid-like than that formed by conventional masonry blocks, such as wall structure 880 illustrated by Figure 20A.

Figures 34A – 34D are simplified illustrations of one implementation of mold assembly 30 and a block formation process for forming masonry block 1030 of Figure 27. Mold assembly 30 includes side members 34a, 34b, cross-members 36a, 36b, stationary liner plates 32b, 32c, and moveable liner plates 32a and 32d. Drive assemblies 31a and 31d are respectively coupled to and configured to extend and retract moveable liner plates 32a and 32d toward and away from the interior of mold cavity 46. Liner faces 100a and 100d are respectively coupled to moveable liner plates 32a and 32d. Liner face 100a comprises a negative of flange 1044 and notch 1046 of end face 1040, and liner face 100d comprises a negative of the desired three-dimensional texture or pattern to be imprinted on front face 1032 of retaining wall block 1030 (see Figure 27).

Figures 34A is top view of mold assembly 30 illustrating moveable liner plates 32a and 32d in their retracted positions. Figure 34B is a top view of mold
assembly 30 illustrating moveable liner plates 32a and 32d in their extended positions at which point concrete is ready to be introduced in to mold cavity 46.

Figures 34C and 34D respectively illustrate simplified cross-sectional views of mold assembly 30 along section line A-A (see Figure 34A) and along section line B-B (see Figure 34B), and further illustrate head shoe assembly 52 and pallet 56. Figure 34C illustrates moveable liner plate 32d and corresponding liner face 100d in their retracted positions, with dashed line 1152 indicating the extended position of liner face 100d. Head shoe assembly 52 further includes a notch 1154 which, in cooperation with stationary liner plate 32b, is configured to form set-back flange 1064 along the edge of bottom face 1038 with rear face 1034 (see Figure 27).

Figure 34D illustrates stationary liner plate 32c and moveable liner plate 32a and corresponding liner face 100a in their extended position. Liner plate 100a cooperates with head shoe assembly cooperate to form flange 1044 and with pallet 56 to from notch 1046 which extend between front and rear faces 1032 and 1034 along first end face 1040 of retaining wall block 1030 (see Figure 27).

Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations may be substituted for the specific embodiments shown and described without departing from the scope of the present invention. This application is intended to cover any adaptations or variations of the specific embodiments discussed herein. Therefore, it is intended that this invention be limited only by the claims and the equivalents thereof.
WHAT IS CLAIMED IS:

1. A masonry block molded by a masonry block machine employing a mold assembly having a plurality of liner plates, at least one of which is moveable; the masonry block comprising:
   a first transverse face;
   a second transverse face opposing the first transverse face;
   a first major face joining the first transverse face to the second transverse face;
   a second major face opposing the first major face and joining the first transverse face to the second transverse face;
   a first end facejoining the first major face to the second major face; and
   a second end face opposing the first end face and joining the first major face to the second major face, wherein the first end face comprises a non-planar face configured to engage and overlap with a non-planar end face of a similar masonry block and is formed during a molding process through action of a moveable liner plate having a negative of the non-planar end face.

2. The masonry block of claim 1, wherein the second end face comprises a non-planar face configured to engage and overlap with a non-planar end face of a similar masonry block and is formed during a molding process through action of a moveable liner plate having a negative of the non-planar end face.

3. The masonry block of claim 1, wherein at least one of the first and second major faces includes a desired three-dimensional pattern which is imprinted during the molding process through action of a moveable liner plate having a negative of the desired three-dimensional pattern.

4. The masonry block of claim 1, wherein the non-planar face of the first end face is formed by a flange extending between the first and second major faces along an edge shared with the second transverse face, the flange defining a substantially parallel notch extending between the first and second major faces.
along an edge shared with the first transverse face, wherein the flange is configured to engage a notch and overlap with a flange of an end face of a similar masonry block.

5. The masonry block of claim 4, wherein the second end face is non-planar and formed by a flange extending between the first and second major faces along an edge shared with the second transverse face, the flange defining a substantially parallel notch extending between the first and second major faces along an edge shared with the first transverse face, wherein the flange is configured to engage a notch and overlap with a flange of an end face of a similar masonry block.

6. The masonry block of claim 4, wherein the second end face is non-planar and formed by a flange extending between the first and second major faces along an edge shared with the first transverse face, the flange defining a substantially parallel notch extending between the first and second major faces along an edge shared with the second transverse face, wherein the flange is configured to engage a notch and overlap with a flange of an end face of a similar masonry block.

7. The masonry block of claim 1, further including one or more apertures extending through the masonry block from the first transverse face to the second transverse face.

8. A retaining wall block molded by a masonry block machine employing a mold assembly having a plurality of liner plates, at least one of which is moveable; the retaining wall block comprising:
   a top face;
   a bottom face opposing the top face;
   a front face joining the top face to the bottom face;
   a rear face opposing the front face;
a set-back flange extending from the bottom face along at least a portion of an edge shared with the rear face and formed by action of a moveable shoe assembly during a molding process;

a first side face joining the front and rear faces; and

a second side face opposite the first side face and joining the front and rear faces, where at least one of the first and second side faces comprises a non-planar face configured to engage and overlap with a non-planar end face of a similar retaining wall block and is formed during a molding process through action of a moveable liner plate having a negative of the non-planar face.

9. The retaining wall block of claim 8, wherein the first and second side faces are angled such that a width of the front face is greater than a width of the rear face.

10. The retaining wall block of claim 8, wherein the front face includes a desired three-dimensional pattern which is imprinted during the molding process through action of a moveable liner plate having a negative of the desired three-dimensional pattern.

11. The retaining wall block of claim 8, wherein the first side face comprises a non-planar face and is formed by a flange extending between the front and rear faces along an edge shared with the bottom face, the flange defining a substantially parallel notch extending between the front and rear faces along an edge shared with the top face, wherein the flange and notch are formed through action of a moveable liner having a negative of the flange and notch, and wherein the flange is configured to engage a notch and overlap with a flange of an end face of a similar retaining wall block.

12. The retaining wall block of claim 11, wherein the second side face comprises a non-planar face and is formed by a flange extending between the front and rear faces along an edge shared with the top face, the flange defining a
substantially parallel notch extending between the front and rear faces along an edge shared with the bottom face, wherein the flange and notch are formed through action of a moveable liner having a negative of the flange and notch, and wherein the flange is configured to engage a notch and overlap with a flange of an end face of a similar retaining wall block.

13. The retaining wall block of claim 8, wherein the first side face comprises a non-planar face and is formed by a flange extending between the front and rear faces along an edge shared with the top face, the flange defining a substantially parallel notch extending between the front and rear faces along an edge shared with the bottom face, wherein the flange and notch are formed through action of a moveable liner having a negative of the flange and notch, and wherein the flange is configured to engage a notch and overlap with a flange of an end face of a similar retaining wall block.

14. The retaining wall block of claim 13, wherein the second side face comprises a non-planar face and is formed by a flange extending between the front and rear faces along an edge shared with the bottom face, the flange defining a substantially parallel notch extending between the front and rear faces along an edge shared with the top face, wherein the flange and notch are formed through action of a moveable liner having a negative of the flange and notch, and wherein the flange is configured to engage a notch and overlap with a flange of an end face of a similar retaining wall block.

15. A method of producing a masonry block having a first major face and an opposing second major face, a first transverse face and an opposing second transverse face, and a first end face and a second end face, the method comprising:

   providing a mold assembly having a plurality of liner plates that form a mold cavity having an open top and an open bottom, wherein at least a first liner
plate is moveable between a retracted position and an extended position, the first
moveable liner plate including a negative of a desired non-planar face;
  moving the first liner plate to the extended position;
closing the bottom of the mold cavity with a pallet;
filling the mold cavity with dry cast concrete via the open top;
closing the top of the mold cavity with a shoe assembly;
  compacting the dry cast concrete to form a pre-cured masonry block with
the first transverse face resting on the pallet, wherein the first moveable liner
plate forms the desired non-planar face in the first end face, the desired non-
planar face configured to engage a non-planar face of a similar masonry block;
  moving the first liner plate to the retracted position;
expelling the pre-cured masonry block from the mold cavity; and
curing the pre-cured masonry block.

16. The method of claim 15, wherein a second liner plate is moveable
between a retracted position and an extended position, the second liner plate
being generally opposite the first liner plate and including a negative of a desired
non-planar face, the method including moving the second liner plate to the
extended position subsequent to compacting the dry cast concrete such that
desired non-planar face is formed in the second end face, the desired non-planar
face configured to engage a non-planar face of a similar masonry block.

17. The method of claim 15, wherein compacting the dry cast concrete
includes forming a set-back flange extending from the second transverse face
along an edge shared with the second major face by providing a notch in the
shoe assembly.

18. The method of claim 15, wherein compacting the dry cast concrete
includes forming one or more hollow cores extending through the masonry block
from the first transverse face to the second transverse face.
19. The method of claim 15, wherein a second liner plate is moveable between a retracted position and an extended position, the second liner plate including a negative of a desired three-dimensional pattern, the method including moving the second liner plate to the extended position subsequent to compacting the dry cast concrete such that desired non-planar face is formed in the first major face.

20. The method of claim 15, wherein the first moveable liner plate forms a desired non-planar face comprising a flange and a substantially parallel notch extending from the first major face to the second major face, the flange configured to engage a notch and overlap a flange in an end face of a similar masonry block.

21. The method of claim 15, wherein the first liner plate is moveable between the retracted and extended positions using a gear drive assembly.
Fig. 19
Fig. 20A  
(PRIOR ART)

Fig. 20B  
(PRIOR ART)
Fig. 23