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(54) HOLLOW BRICK PROVIDING THERMAL INSULATION

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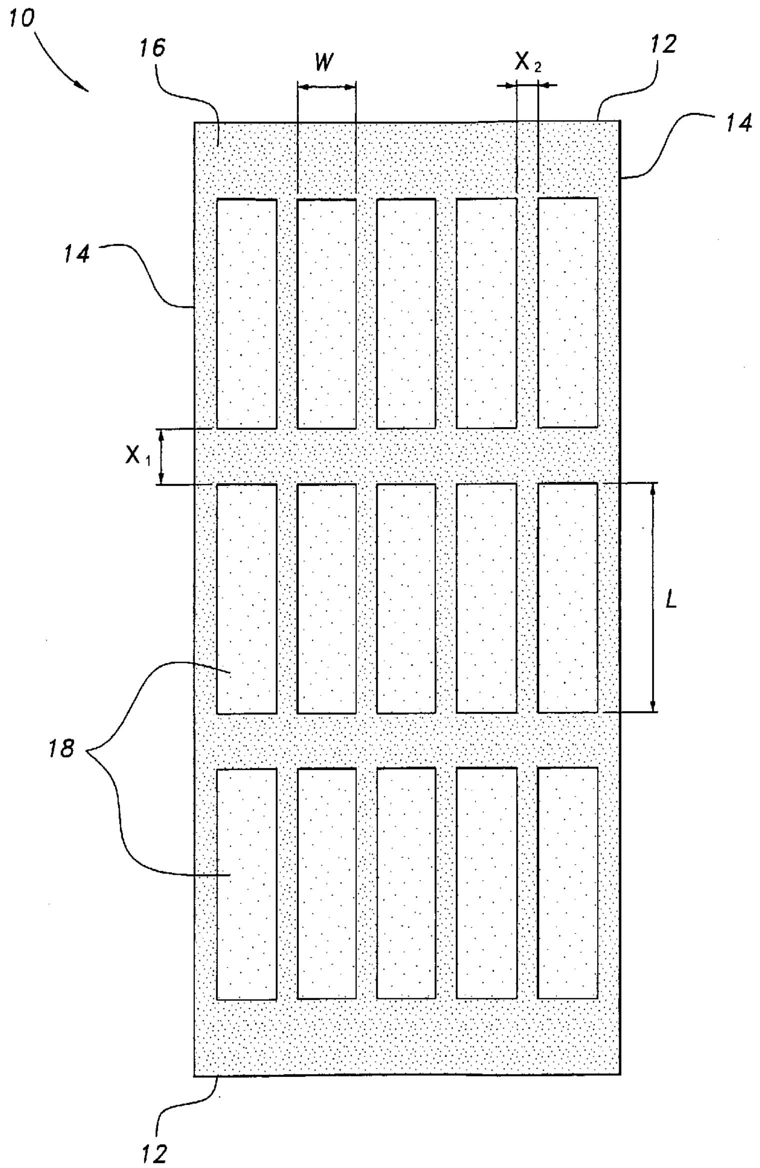
(57) ABSTRACT

The hollow brick providing thermal insulation is a construction block having a relatively high R-value. The hollow brick providing thermal insulation includes a main brick body forming a substantially rectangular prism. The main brick body has opposed upper and lower surfaces, a pair of laterally opposed sidewalls and a pair of longitudinally opposed sidewalls. A plurality of open passages are formed through the main brick body and extend between the upper and lower surfaces thereof. Each open passage defines upper and lower open ends formed through the upper and lower surfaces. The plurality of open passages are arrayed to form a plurality of laterally extending rows and a plurality of longitudinally extending columns. A longitudinal thickness between adjacent ones of the open passages in each longitudinally extending column is greater than a lateral thickness between adjacent ones of the open passages in each laterally extending row.



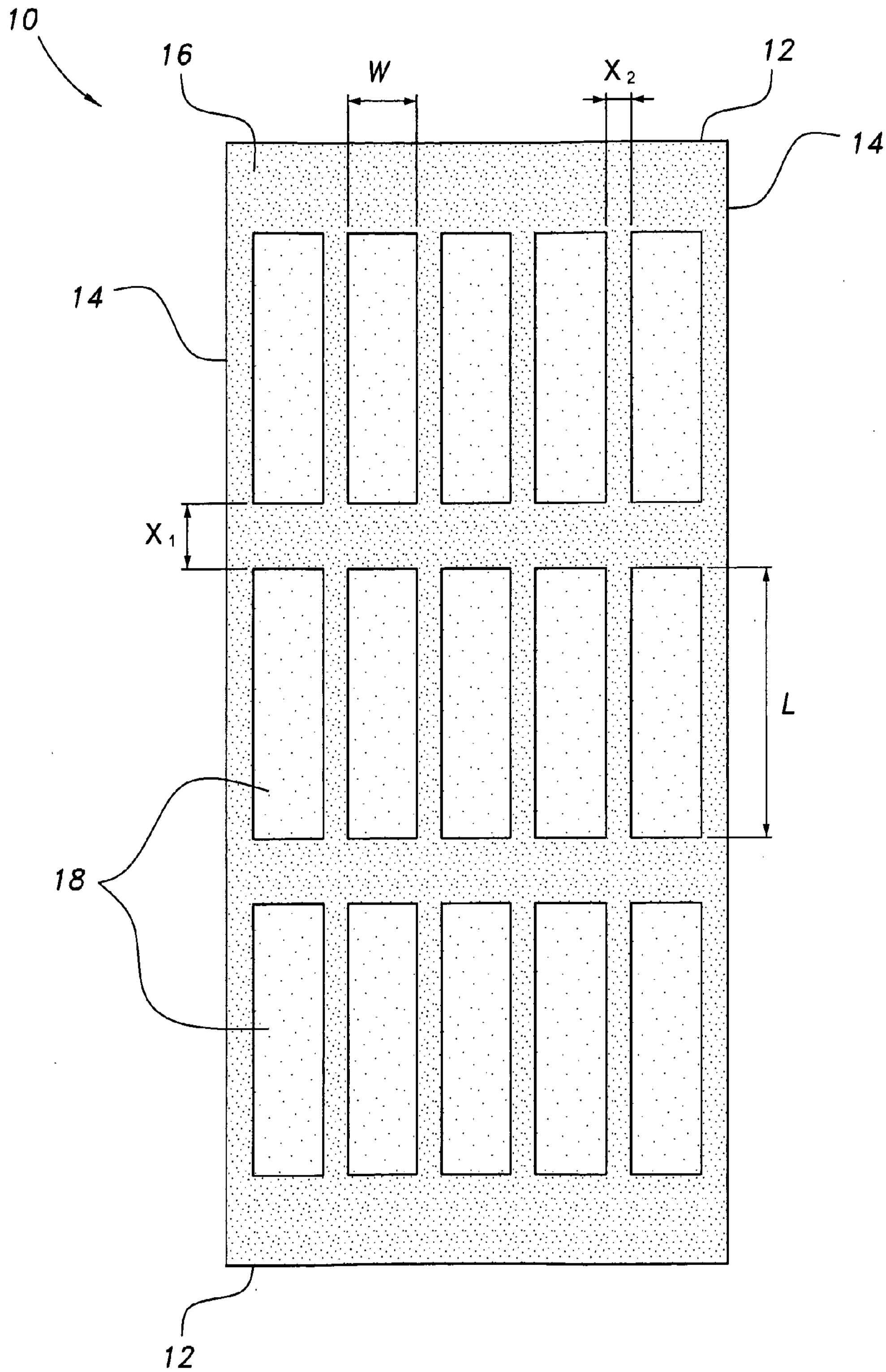


FIG. 1A

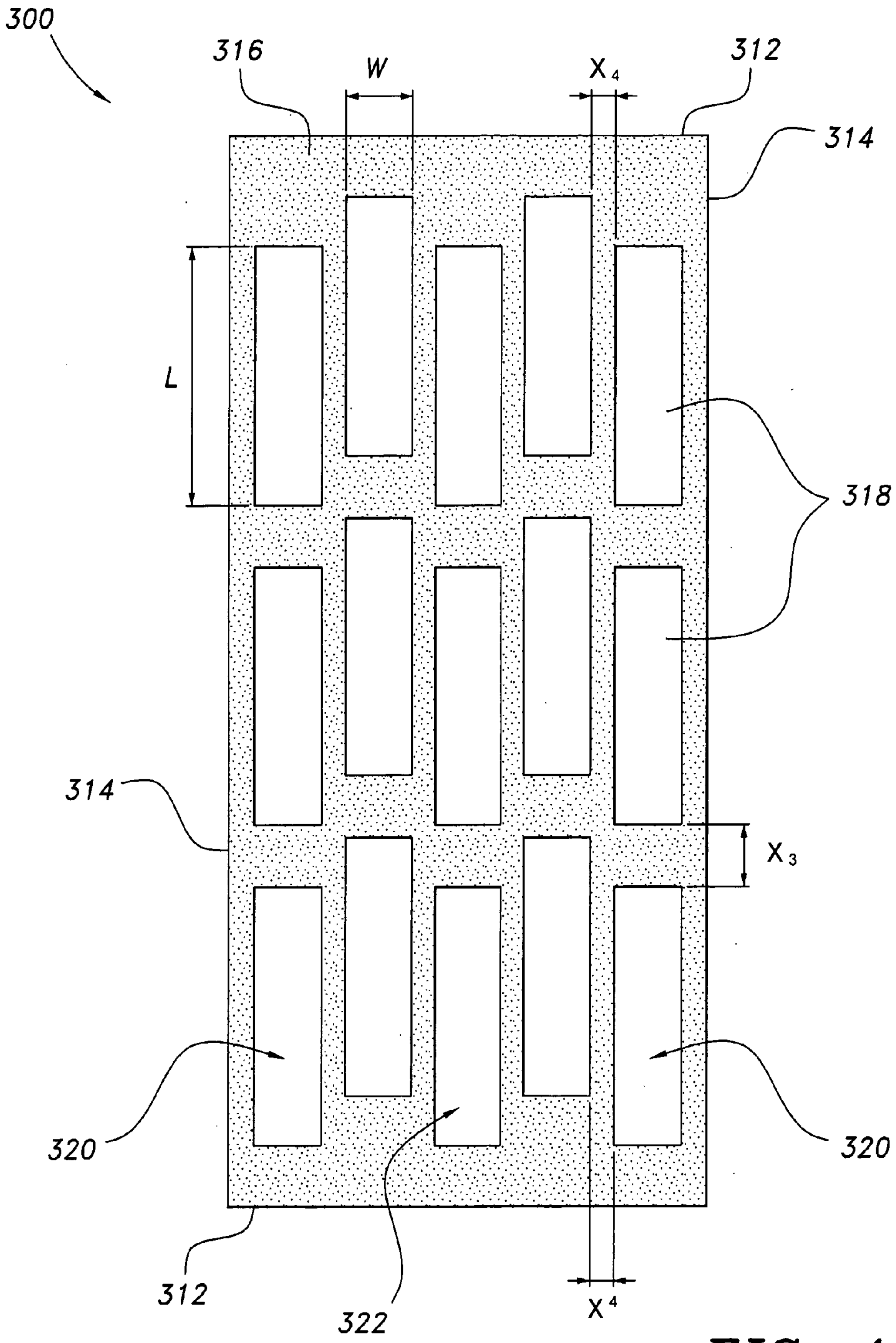


FIG. 1B

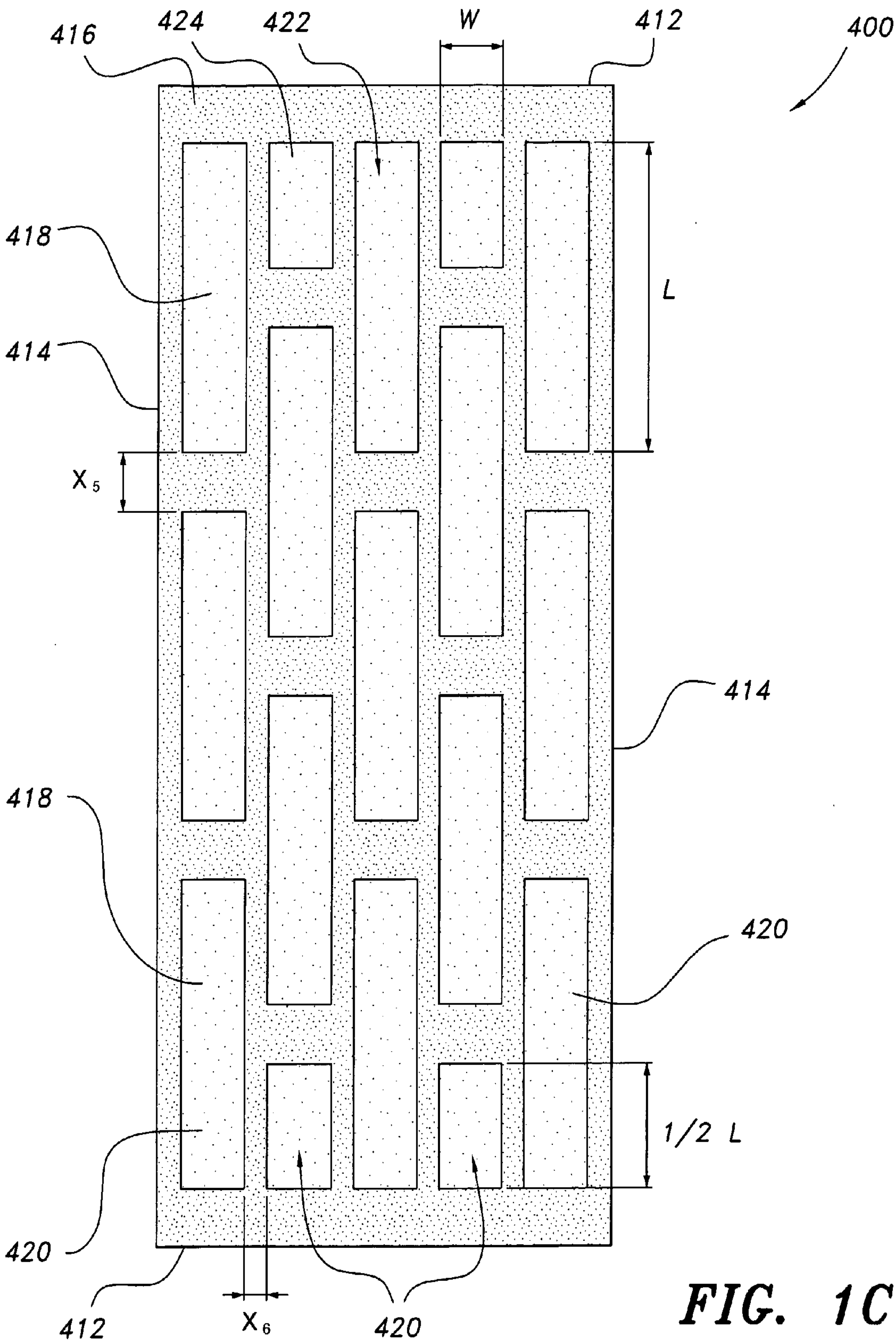


FIG. 1C

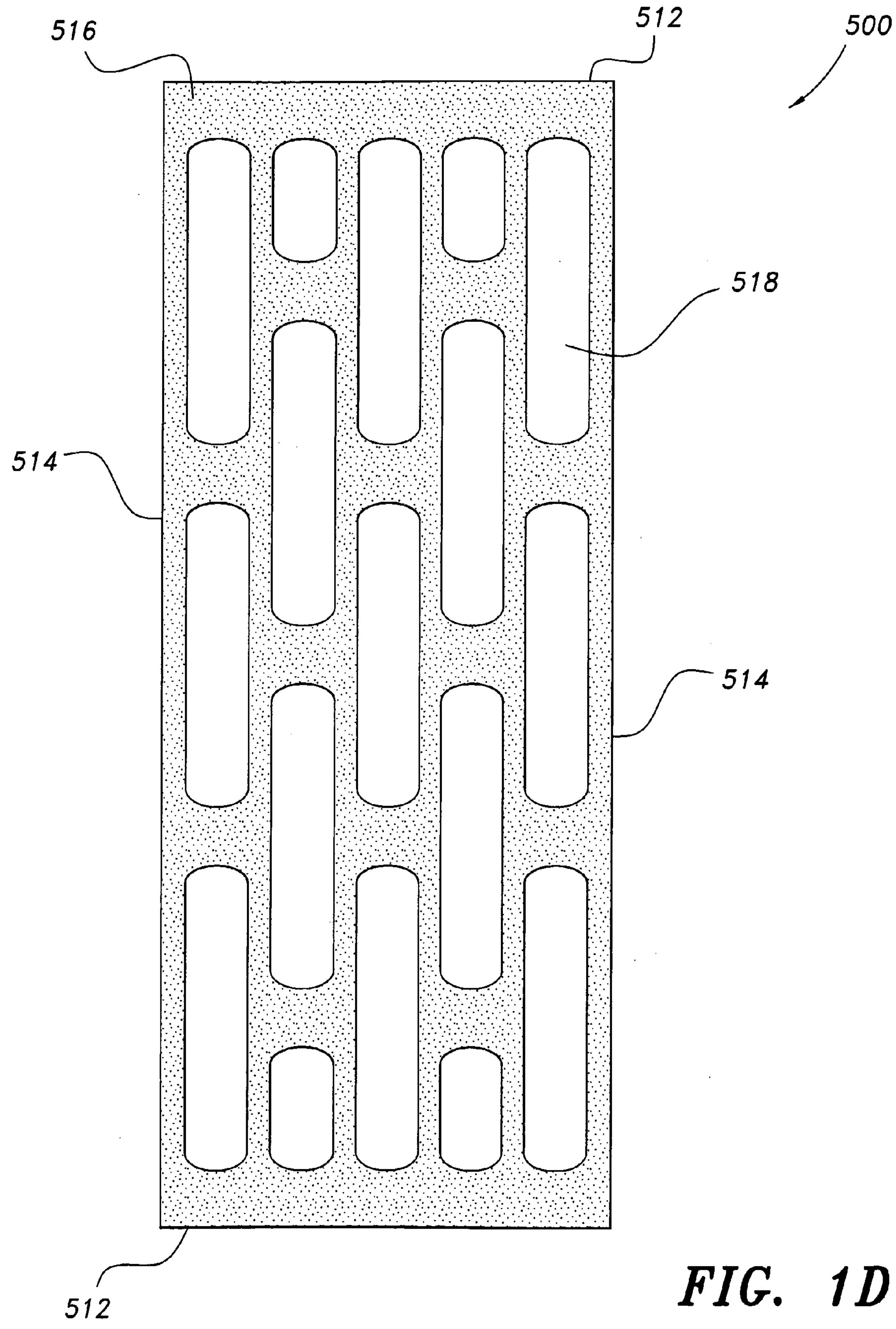


FIG. 1D

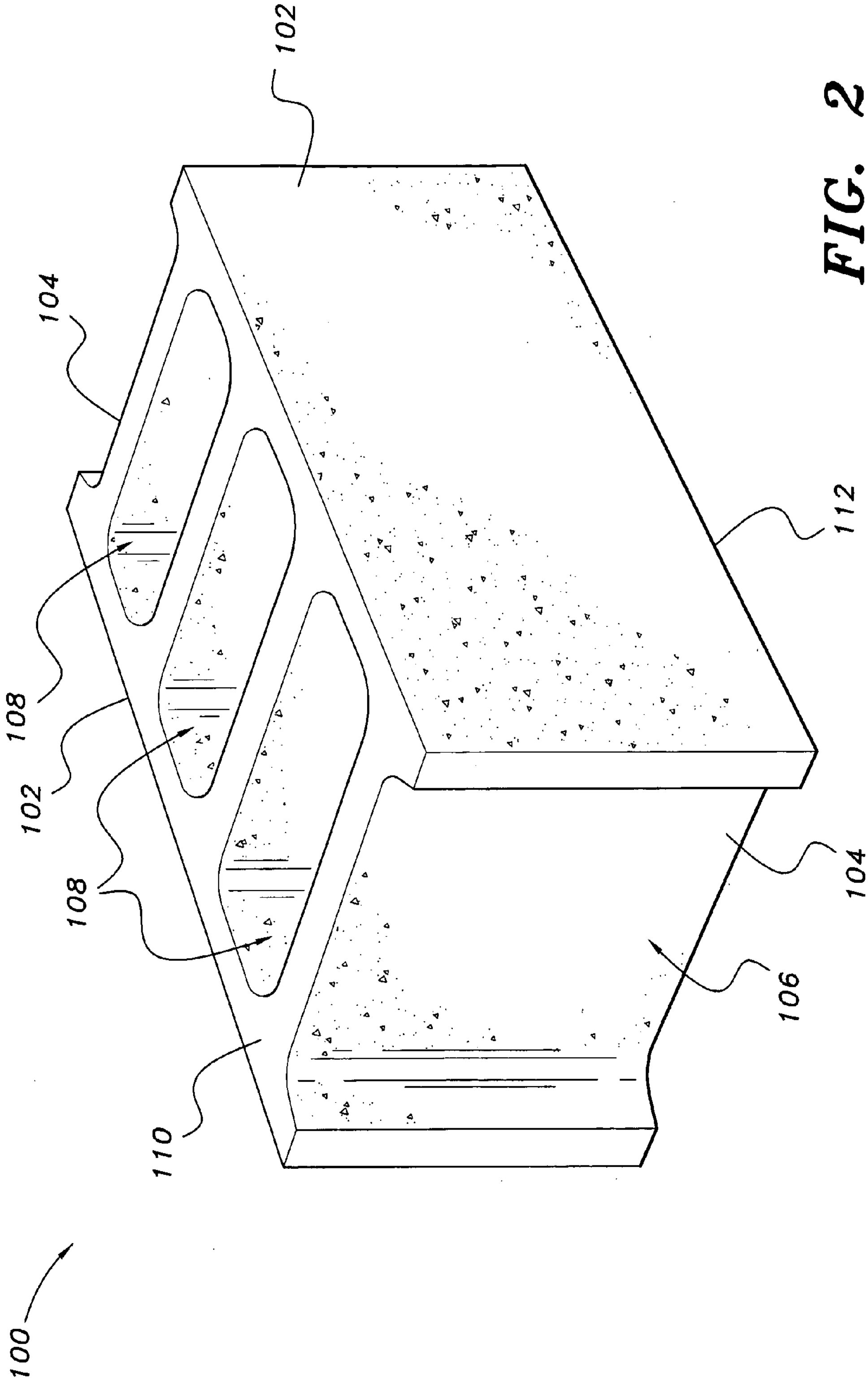


FIG. 2
PRIOR ART

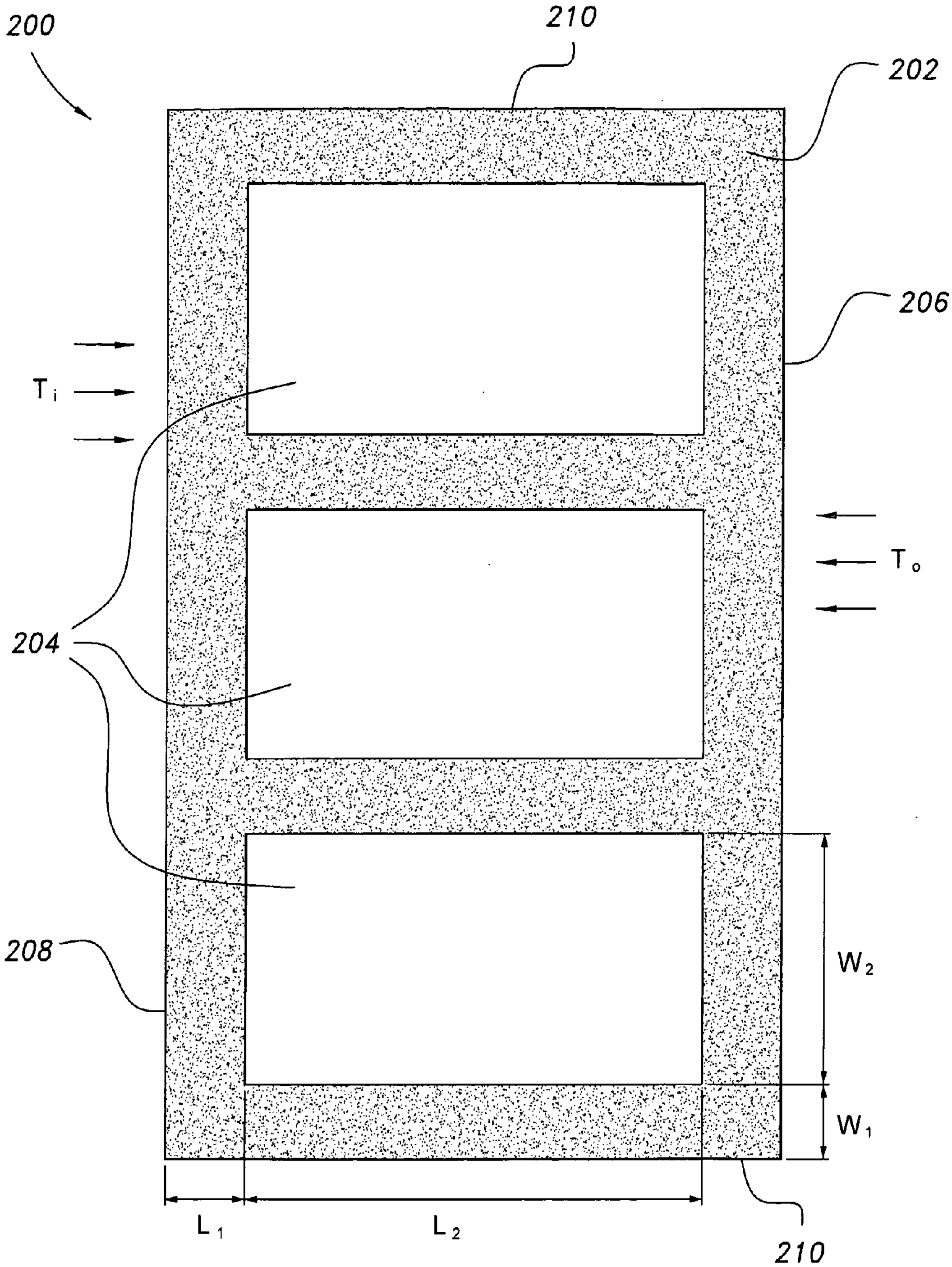


FIG. 3
PRIOR ART

HOLLOW BRICK PROVIDING THERMAL INSULATION

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to construction materials, and particularly relates to a hollow brick providing thermal insulation, the brick having relatively high R-values.

[0003] 2. Description of the Related Art

[0004] In nations where hot weather prevails throughout most of year, such as the Kingdom of Saudi Arabia, a substantial amount of the total power consumption in the nation is expended cooling buildings by air conditioning. Electrical energy is primarily generated through the burning of fossil fuels, which release harmful gases, typically referred to as "greenhouse gases", into the atmosphere. These greenhouse gas emissions contribute to global warming and major changes in climate conditions. At least one-half of the volume of emissions from the power production process is in the form of harmful greenhouse gases.

[0005] Thus, sustainability and energy savings are important issues aimed at the reduction of energy consumption and production of greenhouse gas emissions. Therefore, it is necessary to improve the thermal loss standards of building construction elements.

[0006] Heat leak calculations are of particular importance, since thermal energy transfer through constructions materials (such as wall-forming bricks) directly relates to energy conservation in buildings, and ultimately determines the suitable R-value or U-factor for building elements. In calculating air conditioning cooling load, the heat transmission through walls, in particular, is considered as a major element contributing to loss of efficiency by heating the cooler, air-conditioned air inside the building.

[0007] A substantial amount of energy is consumed to compensate for heat transfer through building walls and ceilings. During the mid-1970's, designers first became aware of the life-cycle cost of buildings, thus initiating the design of energy efficient walls. Walls using hollow bricks were built for their structural and moisture diverting qualities. Hollow bricks are manufactured in a wide variety of styles and sizes. FIG. **2** illustrates a typical hollow brick **100** of the type commonly referred to as a three-core hollow block or concrete masonry unit.

[0008] Hollow brick **100** typically is substantially rectangular, having opposed upper and lower surfaces **110**, **112**, a pair of longitudinally opposed sidewalls **104** (each having a recess **106** formed therein), a pair of laterally opposed sidewalls **102**, and often three open passages **108** defining cores formed transversely therethrough. Alternatively, brick **100** may be described as a rectangular prism having one or two medial partition walls defining one or two cores through the brick **100**. Today, hollow and dense cement or concrete bricks, also sometimes referred to as hollow blocks, are suitable and common alternatives to conventional bricks, and are widely used in construction.

[0009] Such hollow blocks are typically formed from cement, stone chips, stone dust or sand, and are not only cheaper to manufacture than conventional bricks, but have useful thermal properties. FIG. **3** illustrates another typical hollow brick **200**, having longitudinally opposed sidewalls **210**, laterally opposed sidewalls **206**, **208**, an upper surface **202** and three rectangular passages **204** transversely formed therethrough. Typically, passages **204** are open and the dimensions thereof are carefully selected.

[0010] In FIG. **3**, each passages **204** has a cross-sectional longitudinal width of W_2 and a lateral length of L_2, with the longitudinal spacing between the outer-most passage **204** and the sidewall **210** being W_1 (preferably, the spacing between adjacent passages **204** is equivalent), and a lateral spacing between passages **204** and sidewalls **206**, **208** being L_1. L_1, L_2, W_1 and W_2 are selected such that the cross-sectional surface are of each passage **204** is greater than 25 percent of the overall cross-sectional surface area of the block **200**, but is less than 60 percent of the overall surface area.

[0011] The modes by which heat transfer occurs include heat conduction in the solid sections of block **200**, along with natural convection and radiation transfer within the passages **204**. The outer surface **206** is exposed to solar radiation having a temperature of T_o, and the inner surface **208** is cooled by interior air conditioning, having a temperature of T_i, thus providing a thermal gradient for heat transfer to take place. The rate of heat transfer depends upon the material properties, shape and thermal parameters of the block. Typically, in the prior art hollow blocks shown in FIGS. **2** and **3**, insulation is inserted within the passages. In order to conserve energy through reduction of powered air conditioning within a building, constructing a block having optimal insulating properties, or a high R-value, is needed. Thus, a hollow brick providing thermal insulation solving the aforementioned problems is desired.

SUMMARY OF THE INVENTION

[0012] The hollow brick providing thermal insulation is a construction block having a relatively high R-value. The R-value is a commonly used thermodynamic measure of thermal resistance, or the measure of thermal insulation, used in the building and construction industry. A relatively high R-value is a measure of effective thermal insulation in a building material. The hollow brick providing thermal insulation includes a main brick body that is substantially rectangular, with the main brick body having opposed upper and lower surfaces, a pair of laterally opposed sidewalls and a pair of longitudinally opposed sidewalls.

[0013] A plurality of open passages are transversely formed through the main brick body, extending between the upper and lower surfaces thereof, with each open passage defining upper and lower open ends respectively formed through the upper and lower surfaces. The plurality of open passages are arrayed to form a plurality of laterally extending rows and a plurality of longitudinally extending columns. A longitudinal thickness between adjacent ones of the open passages in each longitudinally extending column is greater than a lateral thickness between adjacent ones of the open passages in each laterally extending row. The plurality of open passages each has a longitudinal length and a lateral width associated therewith, with the lateral width of each open passage being equal.

[0014] Preferably, five longitudinally extending columns and three laterally extending rows are formed by the plurality of open passages. Each open passage may be substantially rectangular, with all passages having substantially equal dimensions. The centers of each passage may be laterally aligned with adjacent ones of the open passages in each laterally extending row, and also longitudinally aligned with adjacent one of the open passages in each longitudinally extending row. Alternatively, the centers of the plurality of open passages may be laterally staggered within each laterally extending row. In this arrangement, centers of an outer pair of the plurality of open passages and a central one of the plurality of open passages are laterally aligned within each laterally extending row.

[0015] Alternatively, five longitudinally extending columns of open passages may be formed, with the plurality of open passages in an outer pair of the plurality of longitudinally extending columns and the plurality of open passages in a central longitudinally extending column being arrayed in three laterally extending rows. Centers of each of the plurality of open passages in the outer pair of the plurality of longitudinally extending columns and in the central longitudinally extending column are laterally aligned, however a pair of longitudinally extending columns, each being respectively positioned between one of the outer pair of longitudinally extending columns and the central longitudinally extending column, each have a pair of larger open passages and a pair of smaller open passages.

[0016] The longitudinal length of each open passage in the outer pair of the plurality of longitudinally extending columns and in the central longitudinally extending column is equal, with the longitudinal length of each larger open passage being equal to the longitudinal length of each open passage in the outer pair of the plurality of longitudinally extending columns and in the central longitudinally extending column. However, the longitudinal length of each smaller open passage is equal to approximately one-half the longitudinal length of each larger open passage. Preferably, the pair of smaller open passages in each respective longitudinally extending column are positioned adjacent the longitudinally opposed sidewalls of the main brick body.

[0017] These and other features of the present invention will become readily apparent upon further review of the following specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. **1**A is a top view of a hollow brick providing thermal insulation according to the present invention.

[0019] FIG. **1**B is a top view of an alternative embodiment of the hollow brick providing thermal insulation according to the present invention.

[0020] FIG. **1**C is a top view of another alternative embodiment of the hollow brick providing thermal insulation according to the present invention.

[0021] FIG. **1**D is a top view of another alternative embodiment of the hollow brick providing thermal insulation according to the present invention.

[0022] FIG. **2** is a perspective view of a prior art construction block.

[0023] FIG. **3** is a top view of a prior art hollow brick.

[0024] Similar reference characters denote corresponding features consistently throughout the attached drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] Referring to FIG. **1**A, a first embodiment of the hollow brick providing thermal insulation **10** is shown. The hollow brick **10** is a construction block having a relatively high R-value. The R-value is a commonly used thermodynamic measure of thermal resistance, or the measure of thermal insulation, used in the building and construction industry. A relatively high R-value is a measure of effective thermal insulation in a building material.

[0026] It will be noted that in some contexts the term "brick" is used to refer to a block of ceramic material that is small enough to be picked up with one hand while the other hand is used to manipulate a trowel to spread mortar joining the bricks. Such bricks may be made from clay or shale, calcium silicate (typically sand and lime), or other material that is formed into rectangular prisms by the action of heat and subsequent cooling. A typical size for such bricks is about 8"×4"×2.25". They are commonly used for buildings (particularly for external veneer), pavement, chimneys, furnaces, and the like. These bricks may be solid, or they may have hollow passages for light weight and for insulation purposes.

[0027] By contrast, the term "block" or concrete masonry unit is used to refer to a larger unit that is typically used in foundation walls and the like. Blocks are typically made from cast concrete, i.e., Portland cement and aggregate materials. In high-density blocks, the aggregate material is usually sand and fine gravel. In low density blocks, also called cinder blocks or breeze blocks, the aggregate material may comprise fly ash or bottom ash. Section **2102** of the International Building Code defines a "concrete" masonry unit as a building unit or block larger than 12"×4"×4" made of cement and suitable aggregates, and defines the masonry unit as "hollow" when the net cross-sectional area is less than 75% of the gross cross-sectional area in any plane parallel to the load-bearing surface.

[0028] For purposes of the present application, the term "hollow brick" may refer to either the smaller "brick" or the larger "block" described in the two preceding paragraphs.

[0029] The hollow brick providing thermal insulation **10** includes a main brick body forming a substantially rectangular prism, with the main brick body having opposed upper and lower surfaces (only upper surface **16** is illustrated in the top view of FIG. **1**A, although it should be understood that the lower surface is opposite from and substantially parallel to the upper surface **16**, being identical in appearance), a pair of laterally opposed sidewalls **14** and a pair of longitudinally opposed sidewalls **12**.

[0030] A plurality of open passages **18** are transversely formed through the main brick body and extend between the upper and lower surfaces thereof, with each open passage **18** defining upper and lower open ends formed through the upper and lower surfaces of the main brick body. The plurality of open passages **18** are arrayed to form a plurality of laterally extending rows and a plurality of longitudinally extending columns formed by longitudinal and latitudinal partition walls, respectively. The latitudinal partition walls define a longitudinal thickness x_1 between adjacent ones of the open passages in each longitudinally extending column. The longitudinal partition walls define a lateral thickness x_2 between adjacent ones of the open passages in each laterally extending row. The longitudinal thickness x_1 is greater than the lateral thickness x_2. The plurality of open passages **18** each have a longitudinal length L and a lateral width W. Preferably, each passage **18** is substantially rectangular, and each passage **18** is equal in length L and equal in width W. As noted above, in typical prior art hollow blocks, insulation may be inserted within the open passages. In the hollow bricks shown in FIGS. **1**A, **1**B, **1**C and **1**D, the open passages remain open, utilizing air solely as an insulating material.

[0031] Preferably, five longitudinally extending columns and three laterally extending rows are formed by the plurality of open passages **18** by the brick **10**. In FIG. **1**A, the centers of each passage is laterally aligned with adjacent ones of the open passages **18** in each laterally extending row, and also longitudinally aligned with adjacent ones of the open passages in each longitudinally extending row, thus forming a regular, rectangular grid of passages **18**.

[0032] In the alternative embodiment of FIG. **1**B, the hollow brick providing thermal insulation **300** includes a main brick body defining a substantially rectangular prism. The main brick body has opposed upper and lower surfaces (only upper surface **316** is illustrated in the top view of FIG. **1**B, although it should be understood that the lower surface is opposite from and substantially parallel to the upper surface **316**, being identical in appearance), a pair of laterally opposed sidewalls **314** and a pair of longitudinally opposed sidewalls **312**, similar to that described above with regard to FIG. **1**A. However, as shown in FIG. **1**B, the centers of the plurality of open passages **318** within each row are laterally staggered, alternating between an up and a down position. In this arrangement, centers of an outer pair **320** of the plurality of open passages **318** and a central one **322** of the plurality of open passages **318** are laterally aligned within each laterally extending row.

[0033] As in FIG. **1**A, a longitudinal thickness x_3 between adjacent ones of the open passages in each longitudinally extending column is greater than a lateral thickness x_4 between adjacent ones of the open passages **318** in each laterally extending row. The plurality of open passages **318** each have a longitudinal length L and a lateral width W. Preferably, each passage **18** is substantially rectangular, and each passage **18** is equal in length L and equal in width W. It will be noted that only the end walls **312** extend continuously across the width of brick **300**, breaking any thermally conductive bridge that might otherwise be formed by laterally extending partition walls.

[0034] In the alternative embodiment of FIG. **1**C, the hollow brick providing thermal insulation **400** includes a main brick body forming a substantially rectangular prism. The main brick body has opposed upper and lower surfaces (only upper surface **416** is illustrated in the top view of FIG. **1**C, although it should be understood that the lower surface is opposite from and substantially parallel to the upper surface **416**, being identical in appearance), a pair of laterally opposed sidewalls **414** and a pair of longitudinally opposed sidewalls **412**, similar to that described above with regard to FIGS. **1**A and **1**B. In FIG. **1**C, five longitudinally extending columns of open passages **418** are formed. The open passages in an outer pair **420** of the plurality of longitudinally extending columns **418** and the plurality of open passages in a central longitudinally extending column **422** are arrayed in three laterally extending rows. Centers of each of the plurality of open passages in the outer pair **420** of the plurality of longitudinally extending columns and in the central longitudinally extending column **422** are laterally aligned. A pair of longitudinally extending columns **424** are alternately positioned between one of the outer pair of longitudinally extending columns **420** and the central longitudinally extending column **422**. Each of the alternate columns **424** have a pair of larger open passages and a pair of smaller open passages.

[0035] As in FIGS. **1**A and **1**B, a longitudinal thickness x_5 is defined between adjacent ones of the open passages in each longitudinally extending column, and a lateral thickness x_6 is defined between adjacent ones of the open passages in each laterally extending row. However, as shown, x_5 and x_6 are preferably substantially equal in this embodiment. The larger open passages each have a longitudinal length L and a lateral width W.

[0036] The longitudinal length L of each open passage in the outer pair of the plurality of longitudinally extending columns **420** and in the central longitudinally extending column **422** is equal, defined by L, with the longitudinal length of each larger open passage formed in the columns **424** being equal to the longitudinal length L of each open passage in the outer pair of the plurality of longitudinally extending columns **420** and in the central longitudinally extending column **422**. However, the longitudinal length of each smaller open passage in columns **424** is equal to approximately one-half the longitudinal length of each larger open passage (i.e., ½L). As shown, the width W of each open passage **418** is preferably equal in all columns and rows. Preferably, the pair of smaller open passages in each respective longitudinally extending column **424** are positioned adjacent the longitudinally opposed sidewalls **412** of the main brick body. Once again, only the end walls **412** extend continuously across the width of brick **400**, breaking any thermally conductive bridge that might otherwise be formed by laterally extending partition walls.

[0037] In FIG. **1**C, each passage **418** preferably is substantially rectangular. It should be understood that the shape of passages **418** may be varied. In FIG. **1**D, a hollow brick **500** is provided that has a configuration similar to that shown in FIG. **1**C (i.e., longitudinally opposed sidewalls **512**, laterally opposed sidewalls **514**, an upper surface **516**, and five columns of open passages **518** arrayed in a manner similar to that shown in FIG. **1**C). However, although the open passages **518** are arrayed identically to open passages **418**, each passage **518** is substantially oval. Once again, only the end walls **412** extend continuously across the width of brick **400**, breaking any thermally conductive bridge that might otherwise be formed by laterally extending partition walls.

[0038] In the hollow bricks of FIGS. **1**A, **1**B, **1**C and **1**D, the R-value of each design is substantially greater than that of the conventional bricks and blocks shown in the prior art of FIGS. **2** and **3**. The increase in R-value is effected by the orientation and dimensioning of the open passages, and the reduction in the thickness of the solid material used to form the main brick body. The five columns of openings decreases the volume available to form thermal bridges, thus reducing the rate of heat loss due to thermal conductivity. Additionally, the use of passages having a high aspect ratio decreases the heat transfer effects due to convection. In the configuration of FIG. **1**A, the hollow brick has an R-value approximately 43.16% greater than that of a conventional hollow block. Staggering the passages, as in FIG. **1**B, increases the R-value by an additional 17.65%. It should be understood that in the above, any desired number of columns may be utilized. Preferably, in order to maintain structural stability in addition to the increase in R-value, the number of longitudinally extending columns is greater than three and less than or equal to six.

[0039] It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.

We claim:

1. A hollow brick providing thermal insulation, comprising a main brick body forming a substantially rectangular prism, the main brick body having opposed upper and lower surfaces, a pair of laterally opposed sidewalls, a pair of longitudinally opposed sidewalls, and a plurality of open passages formed through the main brick body, the passages being arrayed to form a plurality of laterally extending rows and a plurality of longitudinally extending columns, the passages being spaced closer together laterally than longitudinally.

2. The hollow brick as recited in claim **1**, wherein each of the open passages is substantially rectangular.

3. The hollow brick as recited in claim **2**, wherein each of the open passages has equal dimensions.

4. The hollow brick as recited in claim **3**, wherein said open passages each have a center, the centers being laterally aligned within each said laterally extending row.

5. The hollow brick as recited in claim **4**, wherein said plurality of longitudinally extending columns comprises five longitudinally extending columns.

6. The hollow brick as recited in claim **6**, wherein said plurality of laterally extending rows comprises three laterally extending rows.

7. The hollow brick as recited in claim **3**, wherein the open passages each have a center, the centers being laterally staggered within each said laterally extending row.

8. The hollow brick providing thermal insulation as recited in claim **7**, wherein said plurality of longitudinally extending columns comprises five longitudinally extending columns.

9. The hollow brick providing thermal insulation as recited in claim **8**, wherein the center of alternating open passages in each said laterally extending row are laterally aligned.

10. The hollow brick providing thermal insulation as recited in claim **9**, wherein said plurality of laterally extending rows comprise three laterally extending rows.

11. A hollow brick providing thermal insulation, comprising a main brick body forming a substantially rectangular prism, the main brick body having opposed upper and lower surfaces, a pair of laterally opposed sidewalls, a pair of longitudinally opposed sidewalls, and a plurality of open passages formed through the main brick body extending between the upper and lower surfaces thereof, the plurality of open passages being arrayed to form a plurality of laterally extending rows and a plurality of longitudinally extending columns, the plurality of open passages each having a longitudinal length and a lateral width, the lateral width of each of the open passages being equal.

12. The hollow brick as recited in claim **11**, wherein said plurality of longitudinally extending columns comprises five longitudinally extending columns.

13. The hollow brick as recited in claim **12**, wherein the open passages in alternate columns are arrayed in three laterally extending rows.

14. The hollow brick as recited in claim **13**, wherein each of the open passages has a center, the centers of the passages in alternating columns being laterally aligned.

15. The hollow brick as recited in claim **14**, wherein said longitudinally extending columns include a pair of alternate columns having a pair of larger open passages and a pair of smaller open passages.

16. The hollow brick as recited in claim **15**, wherein the open passages in alternating columns are equal in length.

17. The hollow brick as recited in claim **16**, each said larger open passage is equal in longitudinal length.

18. The hollow brick providing thermal insulation as recited in claim **17**, wherein each said smaller open passage is equal in length to approximately one-half the longitudinal length of each said larger open passage.

19. The hollow brick providing thermal insulation as recited in claim **18**, wherein each said smaller open passage is positioned adjacent one of the longitudinally opposed sidewalls of said main brick body.

20. The hollow brick providing thermal insulation as recited in claim **19**, wherein each of the open passages is substantially oval.

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