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Flynn et al.

(54) **CEMENTITIOUS PAVER**

(76) Inventors: **Ryan James Flynn**, Saddle River, NJ (US); **Wing-Lung Tang**, Philadelphia, PA (US); **Michelle Mullin**, Philadelphia, PA (US)

Correspondence Address:
BROUSE MCDOWELL LPA
388 SOUTH MAIN STREET, SUITE 500
AKRON, OH 44311 (US)

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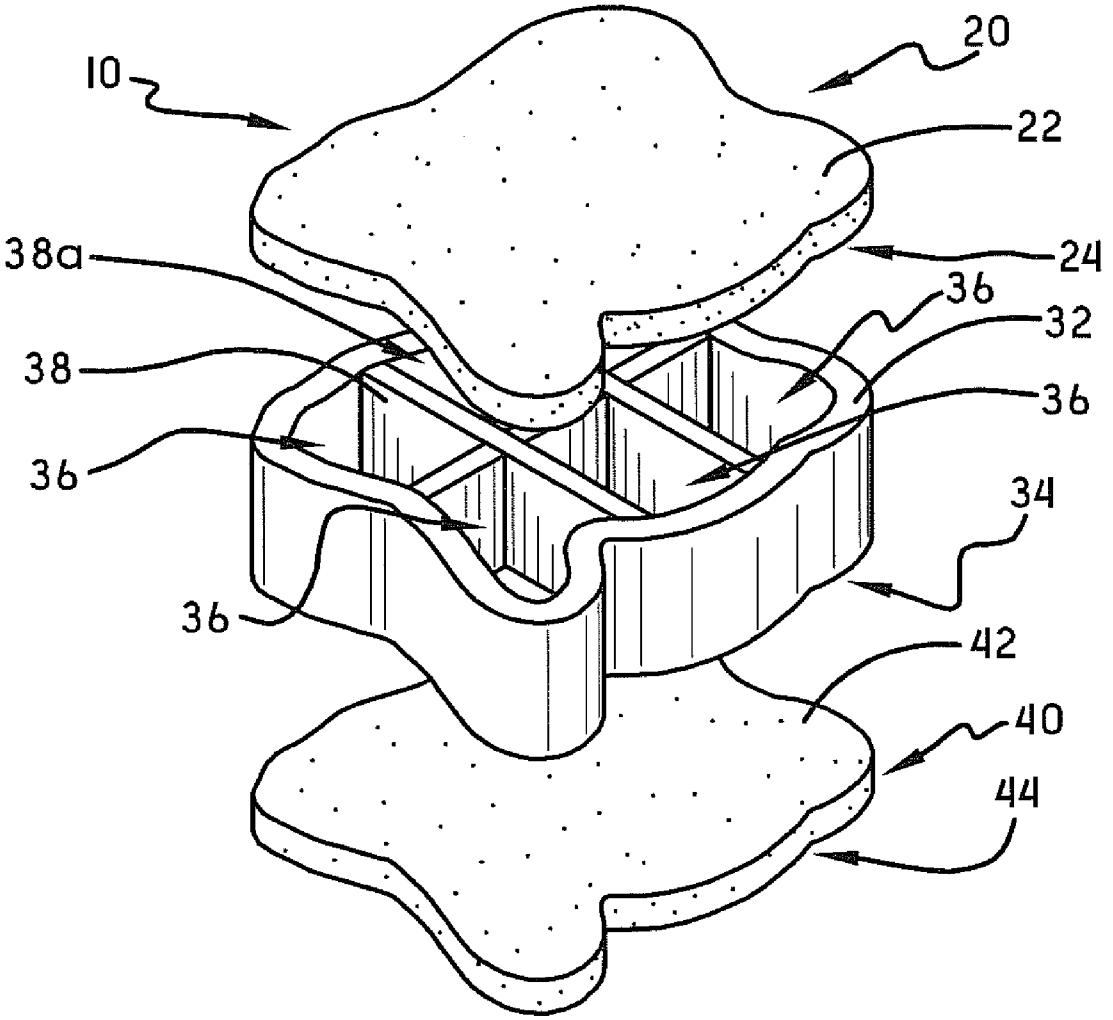
(57) **ABSTRACT**

A cementitious paver comprising a first layer, a second layer, and a third layer. The first layer comprises a surface A, and a surface B opposite said surface A. The first layer comprises a first layer cementitious material that is substantially porous to water. The second layer comprises a surface C and a surface D opposite said surface C. Surface C is engaged with surface B. The second layer comprises a second layer cementitious material that is substantially non-porous to water. The second layer comprises a hole in fluid communication with surface C and in fluid communication with said surface D. The third layer comprises a surface E and a surface F opposite said surface E. Surface E is engaged with surface D. The third layer comprises a third layer cementitious material that is substantially porous to water.



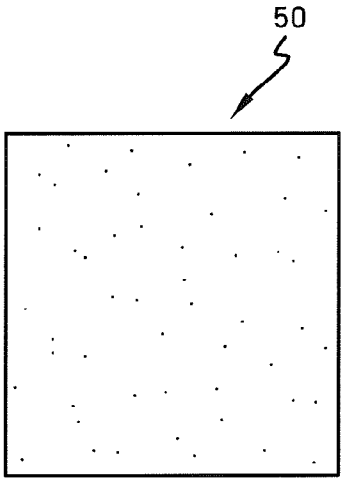


FIG.-1

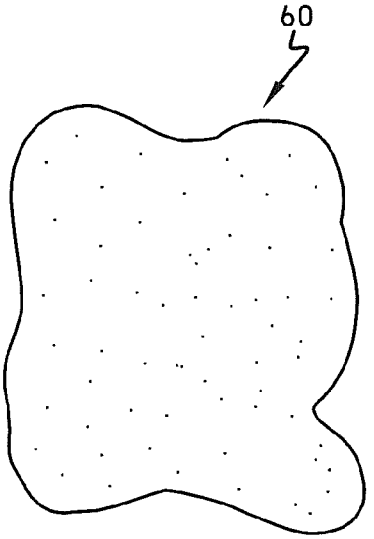


FIG.-4

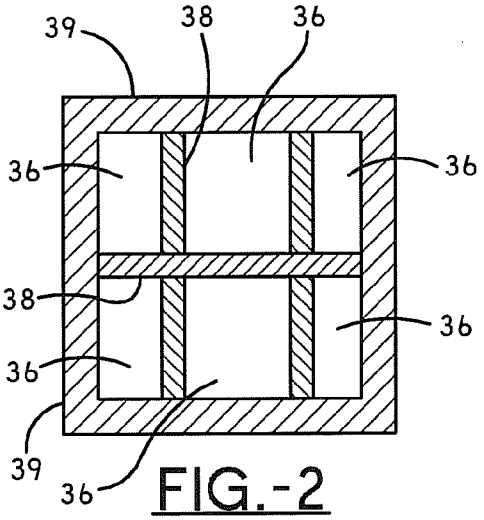


FIG.-2

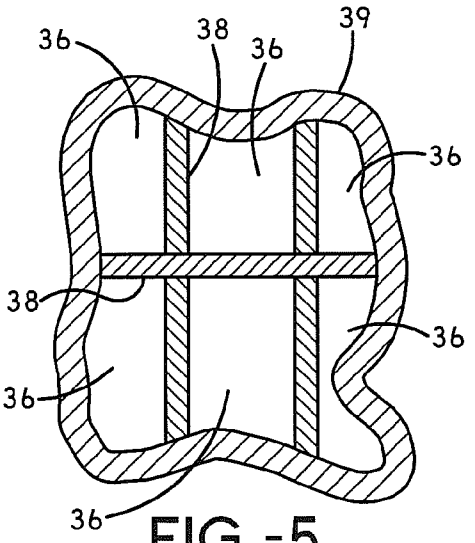


FIG.-5

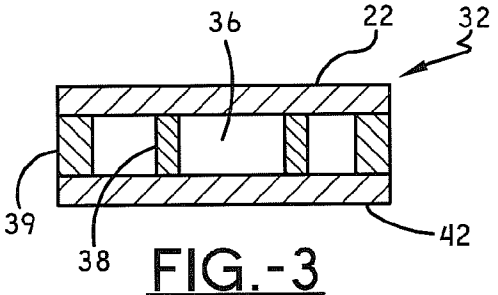


FIG.-3

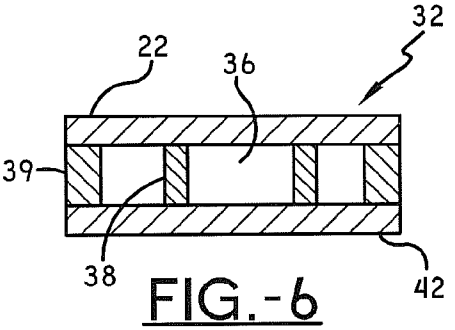


FIG.-6

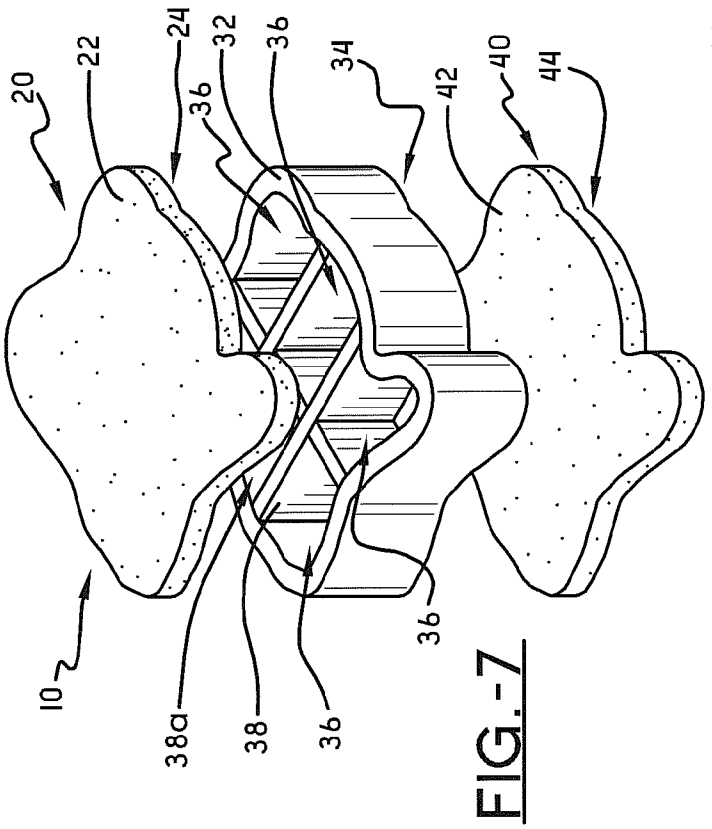


FIG.-7

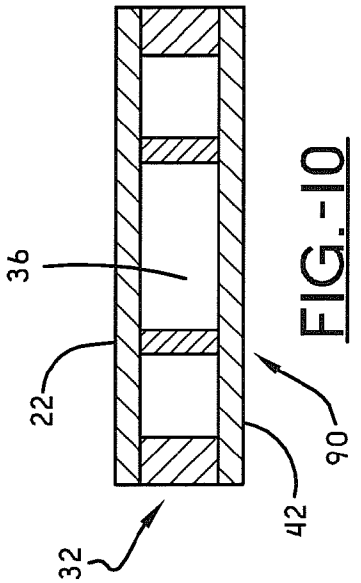


FIG.-10

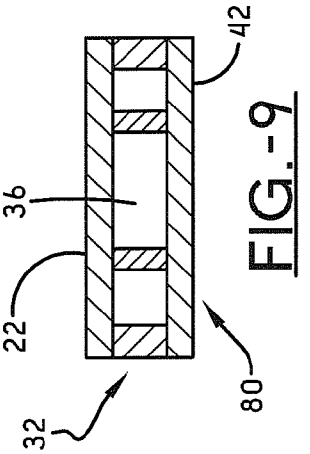


FIG.-9

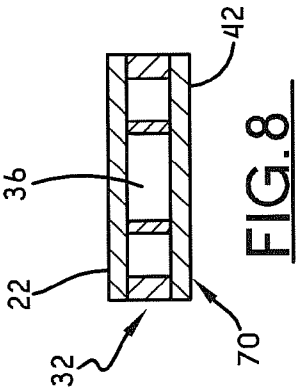


FIG.8

CEMENTITIOUS PAVER

TECHNICAL FIELD

[0001] Provided is a cementitious paver. More particularly, provided is a cementitious paver comprising a plurality of layers; a layer may have a predetermined porosity to water or a predetermined water retention capacity.

BACKGROUND

[0002] Paving regions for various purposes is a common activity. There are many materials and articles from which pavement may be formed. These materials and articles comprise, but are not limited to, macadam, tarmac, bituminous coverings, asphalt, concrete, cobblestones, and pavers.

[0003] Regions are paved for a number of reasons. Pavement selection is made based on various priorities. Pavement selection priorities may comprise, but are not limited to, durability of a surface, drainage properties, dust generation, and maintenance costs.

[0004] Water handling and drainage near paved regions is of special interest because many widely used pavement materials and pavement articles have substantially different permeability or porosity to water than the underlying paved surface, thereby changing water flow and/or absorption at and nearby the paved surface. Many modern pavements, including, but not limited to, concrete and asphalt surfaces are substantially non-porous to water.

[0005] It remains desirable to provide pavement materials which are durable and which are permeable to water.

SUMMARY

[0006] Provided is a cementitious paver comprising a first layer, a second layer, and a third layer. The first layer comprises a surface A, and a surface B opposite said surface A. The first layer comprises a first layer cementitious material that is substantially porous to water. The second layer comprises a surface C and a surface D opposite said surface C. Surface C is engaged with surface B. The second layer comprises a second layer cementitious material that is substantially non-porous to water. The second layer comprises a hole in fluid communication with surface C and in fluid communication with said surface D. The third layer comprises a surface E and a surface F opposite said surface E. Surface E is engaged with surface D. The third layer comprises a third layer cementitious material that is substantially porous to water.

[0007] Provided is a cementitious paver comprising a bottom layer, a middle layer, and a top layer. The bottom layer comprises a top surface, is adapted to filter water therethrough, and comprises a bottom layer concrete. The bottom layer concrete is porous to water. The middle layer comprises a top surface and a bottom surface. The bottom surface is engaged with the top surface of the bottom layer. The middle layer comprises material adapted to substantially occlude the transmission of water therethrough. The middle layer comprises a cavity in fluid communication with the top surface of said middle layer and the bottom surface of said middle layer. The cavity is adapted to store water. The top layer comprises a bottom surface engaged with the top surface of said middle layer, is adapted to filter water therethrough, and comprises a top layer concrete. The top layer concrete is more porous to water than said bottom layer concrete is porous to water.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a top view of one embodiment of a cementitious paver.

[0009] FIG. **2** is a cross-section top view of one embodiment of a cementitious paver.

[0010] FIG. **3** is a cross-section side view of one embodiment of a cementitious paver.

[0011] FIG. **4** is a top view of another embodiment of a cementitious paver.

[0012] FIG. **5** is a cross-section top view of another embodiment of a cementitious paver.

[0013] FIG. **6** is a cross-section side view of another embodiment of a cementitious paver.

[0014] FIG. **7** is an exploded perspective view of an embodiment of a cementitious paver.

[0015] FIG. **8** is a cross-section side view of another embodiment of a cementitious paver.

[0016] FIG. **9** is a cross-section side view of another embodiment of a cementitious paver.

[0017] FIG. **10** is a cross-section side view of another embodiment of a cementitious paver.

DETAILED DESCRIPTION

[0018] A cementitious paver is a paver comprising cementitious materials.

[0019] A paver is an element of a pavement. Pavers are arranged to form the pavement surface. Without limitation, pavement may be the surfacing components of a road, path, sidewalk, court, patio, plaza, or other such area. In certain embodiments, cementitious pavers can be used to pave over grass, soil, sand, gravel, existing concrete, gaps, or combinations thereof. In forming a pavement, the pavers may be joined or spaced apart. Some pavers are adapted to interlock with one another.

[0020] Cementitious materials are materials comprising hydraulic or non-hydraulic cement. Cementitious materials include, without limitation, concrete and cement mortar.

[0021] Reference will be made to the drawings, FIGS. **1-10**, wherein the showings are only for purposes of illustrating certain embodiments of a cementitious paver, and not for purposes of limiting same.

[0022] FIG. **1** shows a non-limiting embodiment of a cementitious paver (**50**). In the embodiment shown in FIG. **1**, the cementitious paver (**50**) has a generally rectangular top surface.

[0023] FIG. **2** is a sectional view of the non-limiting embodiment of a cementitious paver (**50**) shown in FIG. **1**, where the sectional plane is substantially horizontal. In the cross-section of the embodiment shown in FIG. **2**, holes (**36**) have rectangular cross-sections and are bounded by interior walls (**38**) and exterior walls (**39**)

[0024] FIG. **3** is a sectional view of the non-limiting embodiment of a cementitious paver (**50**) shown in FIG. **1**, where the sectional plane is substantially vertical. In the cross-section of the embodiment shown in FIG. **3**, holes (**36**) have rectangular cross-sections and are bounded by interior walls (**38**) and exterior walls (**39**)

[0025] FIG. **4** shows a non-limiting embodiment of a cementitious paver (**60**). In the embodiment shown in FIG. **4**, the cementitious paver (**60**) has an irregular top surface shape.

[0026] FIG. **5** is a sectional view of the non-limiting embodiment of a cementitious paver (**60**) shown in FIG. **4**, where the sectional plane is substantially horizontal. In the cross-section of the embodiment shown in FIG. **5**, holes (**36**) have irregular cross-sections and are bounded by interior walls (**38**) and exterior walls (**39**)

[0027] FIG. **6** is a sectional view of the non-limiting embodiment of a cementitious paver (**60**) shown in FIG. **4**, where the sectional plane is substantially vertical. In the cross-section of the embodiment shown in FIG. **6**, holes (**36**) have rectangular cross-sections and are bounded by interior walls (**38**) and exterior walls (**39**).

[0028] FIG. **7** shows a non-limiting embodiment of a cementitious paver (**10**) in an exploded perspective view. The non-limiting embodiment in FIG. **7** shows three layers. Cementitious pavers are not limited to embodiments with three layers; in certain embodiments cementitious pavers comprise more than three layers. Engagement between surfaces may be direct or through an intermediate component.

[0029] In the non-limiting embodiment in FIG. **7**, the first layer (**20**) is shown as the top layer. The first layer (**20**) is a platen comprising a first surface (**22**) opposite a second surface (**24**). The first layer (**20**) is permeable to water. The first layer (**20**) may be permeable to water due to the material or materials comprising the first layer. In certain embodiments, the material or materials comprising the first layer (**20**) are permeable to water. In certain embodiments, the material or materials comprising the first layer (**20**) are cementitious materials permeable to water. In certain embodiments, the first layer is comprised of permeable cementitious material comprising a mixture of limestone, cement, and a fiberglass aggregate having a first average size. The average size of the fiberglass aggregate is determinative of the permeability of the cementitious materials; larger aggregate results in more permeable cementitious materials. In certain embodiments, the second surface (**24**) of the first layer (**20**) is engaged with the first surface (**32**) of the second layer (**30**).

[0030] In certain embodiments, the material of the cementitious paver comprises a cosmetic surface. A cosmetic surface may comprise, without limitation, stamping, coloring or shaping to produce a desired effect or appearance. Without limitation, in certain embodiments, the top of the first layer is prepared to mimic or appear to be slate, brick, natural stone, neutral concrete, marble, sandstone, or granite.

[0031] In the non-limiting embodiment in FIG. **7**, the bottom layer (**40**) is shown as the third layer. The bottom layer (**40**) is a platen comprising a first surface (**42**) opposite a second surface (**44**). The bottom layer (**40**) is permeable to water. The bottom layer (**40**) may be permeable to water due to the material or materials comprising the bottom layer (**40**). In certain embodiments, the material or materials comprising the bottom layer (**40**) are permeable to water. In certain embodiments, the material or materials comprising the bottom layer (**40**) are cementitious materials permeable to water. In certain embodiments, the bottom layer (**40**) is comprised of permeable cementitious material comprising a mixture of limestone, cement, and a fiberglass aggregate having a second average size. In certain embodiments the second average size of the aggregate is smaller than the first average size of the aggregate. In certain embodiments, the first surface (**44**) of the bottom layer (**40**) is engaged with the second surface (**34**) of the median layer (**30**). In certain embodiments, the permeability to water of the bottom layer (**40**) is less than the permeability to water of the first layer (**20**). In certain embodiments the second average size of the aggregate is smaller than the first average size of the aggregate.

[0032] In the non-limiting embodiment in FIG. **7**, the median layer (**30**) is shown as the second layer. The median layer (**30**) is a platen comprising a first surface (**32**) opposite a second surface (**34**) and a plurality of holes (**36**) that fluidly connect the first surface (**32**) to the second surface (**34**). The median layer (**30**) is permeable to water. The median layer (**30**) is permeable to water due to the geometry of the median layer (**30**); that is, the median layer (**30**) is permeable because it comprises a hole or holes (**36**) that permit fluid flow therethrough. The hole or holes (**36**) have some volume and can also store water therein. The material or materials comprising the median layer (**30**) are impermeable to water. In certain embodiments, the material or materials comprising the median layer (**30**) are cementitious materials impermeable to water. Without limitation, in certain embodiments, the holes (**36**) are shown bounded by at least one interior wall (**38**) and at least one exterior wall (**39**). In certain embodiments, a hole (**36**) is bounded by at least one exterior wall (**39**). Without limitation, in certain embodiments, the interior wall (**38**) comprises a top surface (**38***a*) substantially co-planar with first surface (**32**) and a bottom surface (**38***b*) substantially co-planar with second surface (**34**). Without limitation, in certain embodiments in which, the second surface (**24**) of the first layer (**20**) is engaged with the first surface (**32**) of the median layer (**30**), the top surface (**38***a*) of the interior wall (**38**) may be engaged with the second surface (**24**) of the first layer (**20**). In certain embodiments, the median layer (**30**) comprises support elements. In certain embodiments, support elements comprise a molded polymer, concrete, or metallic components. In certain embodiments, the median layer (**30**) comprises molded PVC grid support elements.

[0033] The holes (**36**) shown in FIG. **7** have irregular cross-sectional shapes, but this shape is not critical and other shapes would be equally acceptable. In certain embodiments, a median layer is present that comprises a first surface and a second surface fluidly connected by a hole or holes (**36**) through the median layer wherein the horizontal cross-section of the holes (**36**) are circular, rectangular, hexagonal, elliptical, square, triangular, quadrilateral, or combinations thereof. In the non-limiting embodiment shown in FIG. **2**, the horizontal cross-sections of the holes (**36**) are rectangular.

[0034] The size of the cementitious pavers and the size of elements comprising the cementitious pavers are may vary greatly amongst embodiments. In certain embodiments cementitious pavers are small stepping stones. In certain embodiments cementitious pavers are large slabs. The size of the holes (**36**) shown in FIG. **7** is not critical and other sizes would be equally acceptable. The cross-sectional area of the hole or holes may range from nearly as large as the area of the second layer platen to small enough to have important capillary effects. In certain embodiments, the horizontal cross-sectional area of the holes is greater than 1 square foot. Without limitation, FIG. **8** shows a sectional view of a non-limiting embodiment of a cementitious paver (**70**), where the sectional plane is substantially vertical. Without limitation, FIG. **9** shows a sectional view of a non-limiting embodiment of a cementitious paver (**80**), where the sectional plane is substantially vertical. Cementitious paver (**80**) is larger than cementitious paver (**70**). Cementitious paver (**80**) is higher and wider than cementitious paver (**70**) and the elements comprising cementitious paver (**80**), including but not limited to the holes (**36**) and the interior walls (**38**), are larger than the

corresponding elements comprising cementitious paver (**70**). Without limitation, FIG. **10** shows a sectional view of a non-limiting embodiment of a cementitious paver (**90**), where the sectional plane is substantially vertical. Cementitious paver (**90**) is larger than cementitious paver (**80**). Cementitious paver (**90**) is higher and wider than cementitious paver (**80**) and the elements comprising cementitious paver (**90**), including but not limited to the holes (**36**) and the interior walls (**38**), are larger than the corresponding elements comprising cementitious paver (**80**). In the embodiments shown in FIGS. **8-10**, the larger the cementitious paver, the larger the holes and thicker the interior walls. A relationship in which the larger the cementitious paver, the larger the holes and thicker the interior walls, is not necessary and is not limiting. In certain embodiments, it is acceptable for larger cementitious pavers to comprise smaller holes and thinner interior walls than those of smaller cementitious pavers.

[0035] In certain embodiments, the top layer is permeable to water and is adapted to filter water that passes therethrough. The filtration properties of the first layer purify the water that passes therethrough of the materials filtered out. In certain embodiment, the first layer comprises a porous cementitious material that enables water to pass through, but which presents a barrier to the flow of particles larger than a pre-determined size, thereby being adapted to filter out those particles larger than the pre-determined size.

[0036] Without limitation, in certain embodiments, the paver is adapted to accumulate water. In water accumulation adapted pavers, the bottom layer is permeable to water, the top layer is permeable to water and is more permeable than is the bottom layer, and the hole or holes in the median layer are large enough to permit water therein to drip or flow therethrough with very little or substantially no resistance. In such embodiments, introduction of water to the top surface of the first layer will cause water to permeate the top layer and flow therethrough at some first rate. The water that flows through the top layer will flow into the median layer through the hole or holes in the median layer. Because the holes in the median layer provide fluid communication between the surfaces of the median layer and provide little or substantially no resistance to water flow therein, the water flowing from the bottom of the top layer can readily flow to the top of the bottom layer. Because the bottom layer is less permeable than the top layer, water introduced thereto will flow therethrough at some second rate less than the first rate. Consequently, water will enter the holes of the median layer at a greater rate than it will exit the holes of the median layer; accordingly, the median layer will accumulate water in the hole or holes therein.

[0037] As water accumulates in the median layer, the water level will rise within at least one hole (**36**) therein. Because the flow outflow from the bottom layer may be a function of, among other variables, the pressure of the fluid within the median layer, a higher fluid level within the median layer will present a higher pressure to the bottom layer and will correlate to a higher fluid outflow rate through the bottom layer.

[0038] In certain embodiments of water accumulation adapted pavers, light rainfall or light water flow is accumulated in the pavers and is released into the paved region over some extended period of time to reduce or eliminate the need for additional water handling or drainage planning or construction.

[0039] In certain embodiments of water accumulation adapted pavers, the paver will have an overflow adaption. In overflow adapted pavers, if rainfall or water flow is high enough to fill the hole or holes of the median layer of the pavers, additional water flow directed to the paver will result in an overflow condition.

[0040] In certain overflow adapted pavers, the paver is adapted to collect water until the water level reaches the top surface of the first layer. In pavers wherein the water level reaches the top surface of the first layer, additional water directed to the top of the paver will result in an equal volume of water flowing off of the top surface. Some overflow adapted pavers comprise a top surface patterned to create a flow path for water flowing off of the top surface. Top surface patterns to create a flow path for water flowing off of the top surface may include, but are not limited to, domes, slants, flow channels, and ribs. In certain embodiments, top surface patterns to create a flow path for water flowing off of the top surface include or are incorporated into a cosmetic surface. Top surface patterns to create a flow path for water flowing off of the top surface are adapted to direct excess water to the gaps between cementitious paver or at the border of a collection of cementitious pavers so that it can flow to ground.

[0041] In certain embodiments, cementitious pavers comprise reinforcing bars.

[0042] While the cementitious paver has been described above in connection with the certain embodiments, it is to be understood that other embodiments may be used or modifications and additions may be made to the described embodiments for performing the same function of the cementitious paver without deviating therefrom. Further, all embodiments disclosed are not necessarily in the alternative, as various embodiments may be combined to provide the desired characteristics. Variations can be made by one having ordinary skill in the art without departing from the spirit and scope of the cementitious paver. Therefore, the cementitious paver should not be limited to any single embodiment, but rather construed in breadth and scope in accordance with the recitation of the attached claims.

I claim

1. A cementitious paver comprising:

a first layer,

said first layer comprising a surface A, and a surface B opposite said surface A,

said first layer comprising a first layer cementitious material, said first layer cementitious material being substantially porous to water;

a second layer,

said second layer comprising a surface C and a surface D opposite said surface C, said surface C engaged with said surface B,

said second layer comprising a second layer cementitious material, said second layer cementitious material being substantially non-porous to water;

said second layer comprising a hole,

said hole in fluid communication with said surface C,

said hole in fluid communication with said surface D; and

a third layer,

said third layer comprising a surface E and a surface F opposite said surface E, said surface E engaged with said surface D,

said third layer comprising a third layer cementitious material, said third layer cementitious material being substantially porous to water.

2. The cementitious paver of claim 1, wherein said third layer cementitious material is less porous to water than said first layer cementitious material.

3. The cementitious paver of claim 2 wherein said
first layer cementitious material is adapted to filter water passing therethrough, or
said third layer cementitious material is adapted to filter water passing therethrough.

4. The cementitious paver of claim 3 wherein said hole is adapted to store water;

5. The cementitious paver of claim 4 wherein said first layer cementitious material comprises porous limestone aggregate.

6. The cementitious paver of claim 5 wherein said first layer cementitious material comprises a cement selected from the group consisting of Portland cement, calcium aluminate cements, and combinations thereof.

7. The cementitious paver of claim 6 wherein said first layer cementitious material comprises an aggregate of fiberglass.

8. The cementitious paver of claim 7 wherein said third layer cementitious material comprises,
porous limestone aggregate, wherein said porous limestone aggregate is smaller than said porous limestone aggregate comprising the first layer cementitious material;
a cement selected from the group consisting of Portland cement, calcium aluminate cements, and combinations thereof; and
an aggregate of fiberglass.

9. The cementitious paver of claim 8 wherein said second layer comprises a plurality of holes.

10. The cementitious paver of claim 9 wherein said second layer comprises a plurality of holes,
said holes in fluid communication with said surface C; and
said holes in fluid communication with said surface D.

11. The cementitious paver of claim 10 further comprising reinforcement materials.

12. The cementitious paver of claim 11 wherein said second layer comprises molded PVC.

13. The cementitious paver of claim 12 wherein said first layer comprises a cosmetically enhanced surface, wherein said cosmetically enhanced surface has been enhanced by a method selected from the group consisting of stamping, coloring, dyeing, pigmenting, or shaping.

14. The cementitious paver of claim 13 wherein said cosmetically enhanced surface has the appearance of slate, brick, natural stone, neutral concrete, marble, sandstone, or granite.

15. A cementitious paver comprising:
a bottom layer,
said bottom layer comprising a top surface,
said bottom layer adapted to filter water therethrough, and
said bottom layer comprising a bottom layer concrete, said bottom layer concrete being porous to water;
a middle layer,
said middle layer comprising a top surface and a bottom surface, said bottom surface engaged with the top surface of said bottom layer,
said middle layer comprising material adapted to substantially occlude the transmission of water therethrough,
said middle layer comprising a cavity in fluid communication with said top surface of said middle layer and said bottom surface of said middle layer, and
said cavity being adapted to store water; and
a top layer,
said top layer comprising a bottom surface, said bottom surface engaged with the top surface of said middle layer,
said top layer adapted to filter water therethrough, and
said top layer comprising a top layer concrete that is more porous to water than said bottom layer concrete is porous to water.

16. The cementitious paver of claim 15, wherein said bottom layer porous concrete comprises,
porous limestone aggregate,
a cement selected from the group consisting of Portland cement, calcium aluminate cements, and combinations thereof; and
an aggregate of fiberglass.

17. The cementitious paver of claim 16, wherein said top layer porous concrete comprises,
porous limestone aggregate,
a cement selected from the group consisting of Portland cement, calcium aluminate cements, and combinations thereof; and
an aggregate of fiberglass.

18. The cementitious paver of claim 17, wherein said middle layer comprises, a plurality of cavities in fluid communication with said top surface of said middle layer and said bottom surface of said middle layer, said cavities being adapted to store water.

19. The cementitious paver of claim 18 wherein said middle layer comprises molded PVC.

20. The cementitious paver of claim 12 wherein said top layer comprises a cosmetically enhanced surface,
wherein said cosmetically enhanced surface has been enhanced by a method selected from the group consisting of stamping, coloring, dyeing, pigmenting, or shaping; and
wherein said cosmetically enhanced surface has the appearance of slate, brick, natural stone, neutral concrete, marble, sandstone, or granite.

* * * * *