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WO 2017/093772 A1 **WO 2007/105955 A1**
US 5192161 A

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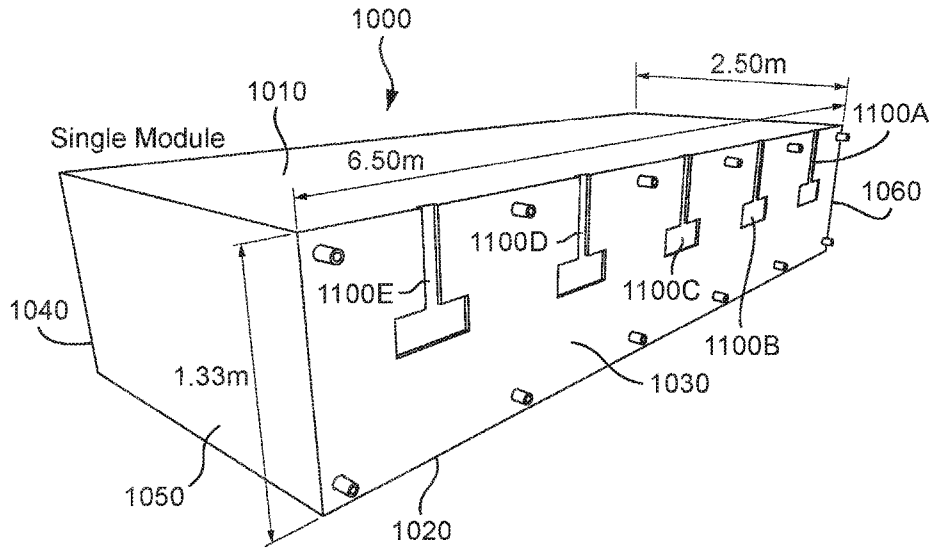
INT CL **B63B, E02B**
Other: **WPI, EPODOC**

(54) Title of the Invention: **A modular concrete floating platform system**
Abstract Title: **A modular concrete floating platform system**

(57) A modular concrete floating platform system comprising a plurality of concrete floating blocks 1000. Each concrete floating block is filled with a buoyant material and comprises a submerged face 1020 configured to be submerged in water, and an exposed face 1010 configured to be exposed when the block is floating on water. Each block further comprises a pair of opposing sides 1030 and 1040 connecting the submerged face to the exposed face. Each of the opposing sides comprises a plurality of recesses 1100A to 1100E and a plurality of lumens for receiving respective connecting bars (1200A to 1200L, Fig 11B) to couple a first concrete floating block adjacent to a second concrete floating block. The recesses on an opposing side of the first concrete floating block abut and align with the recesses on an opposing side of the second concrete floating block to thereby form a plurality of voids between the adjacent concrete floating blocks, and wherein the plurality of voids between adjacent concrete floating blocks are filled with grout.

Fig. 11A



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig. 1A

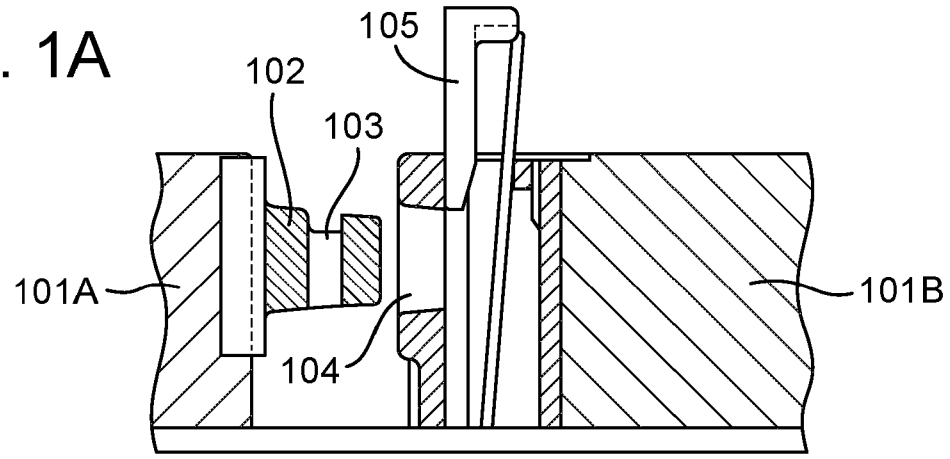

Fig. 1B

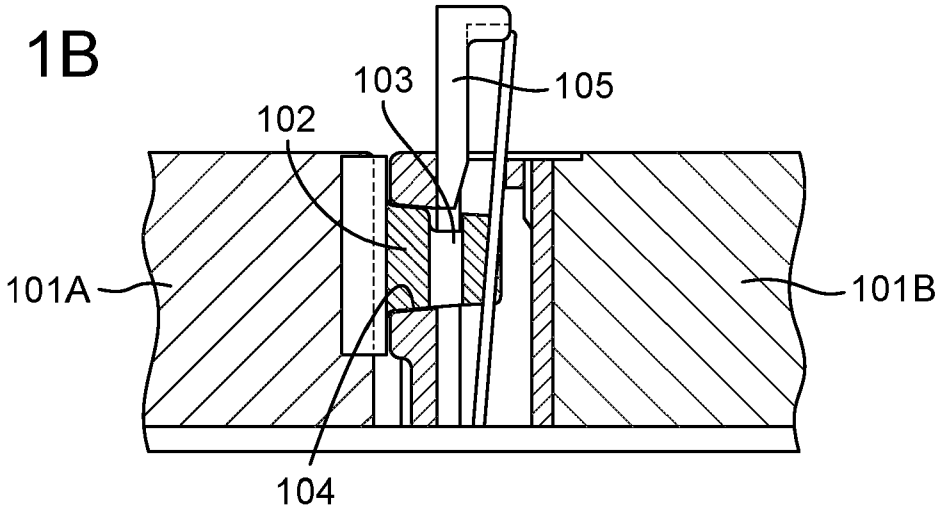

Fig. 1C

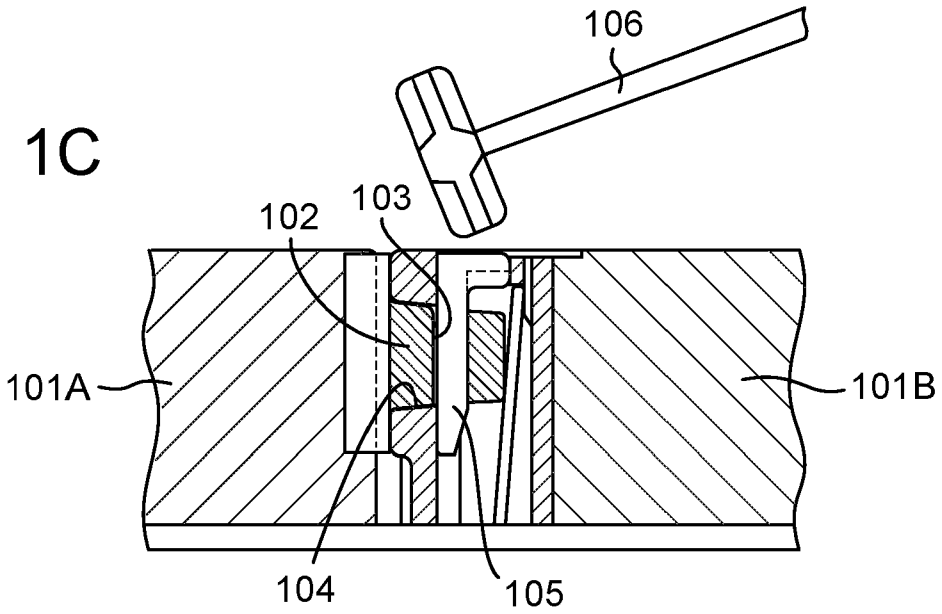

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Fig. 2

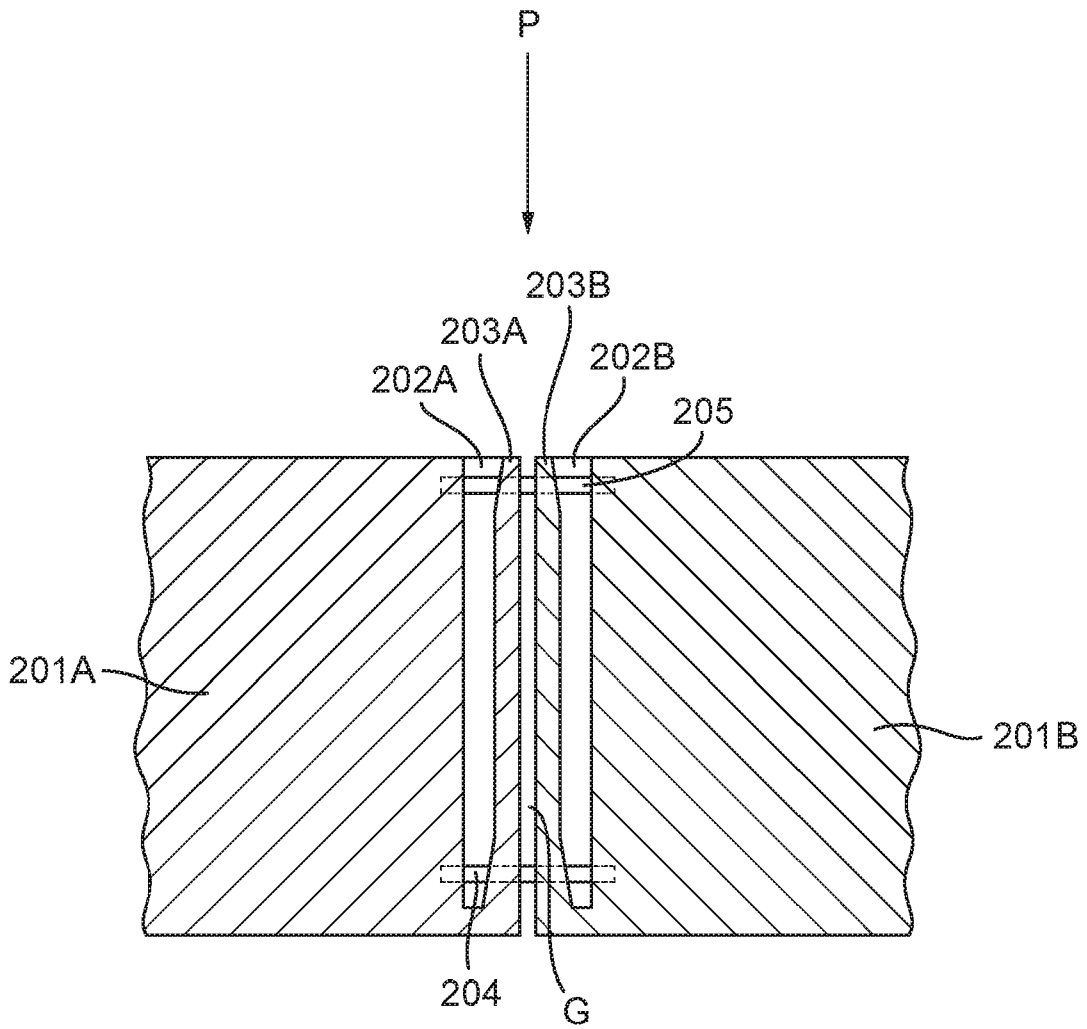

Fig. 3A

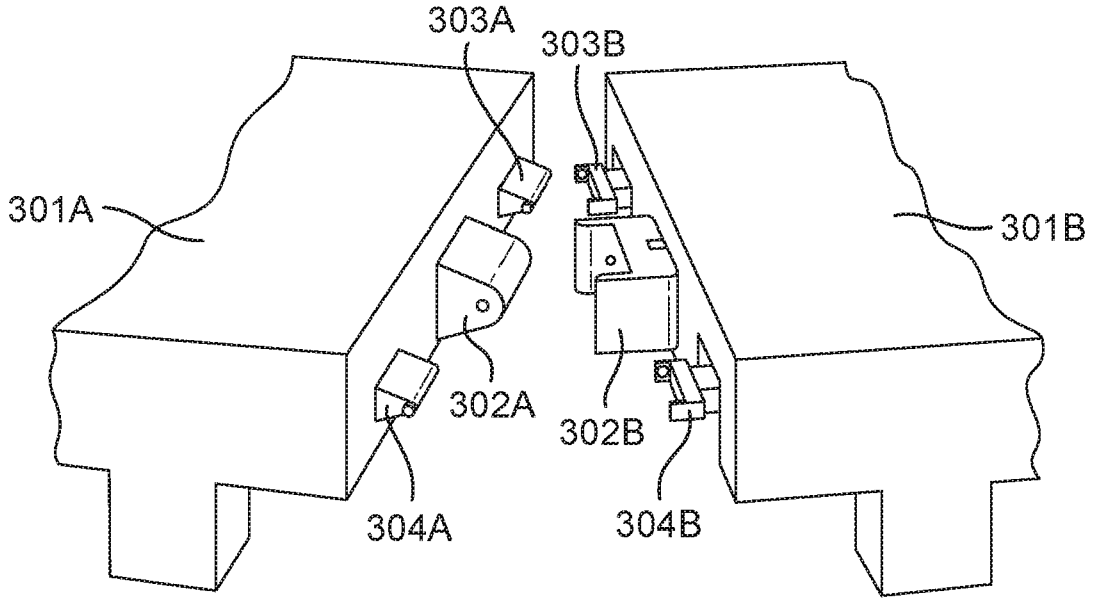

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Fig. 3B

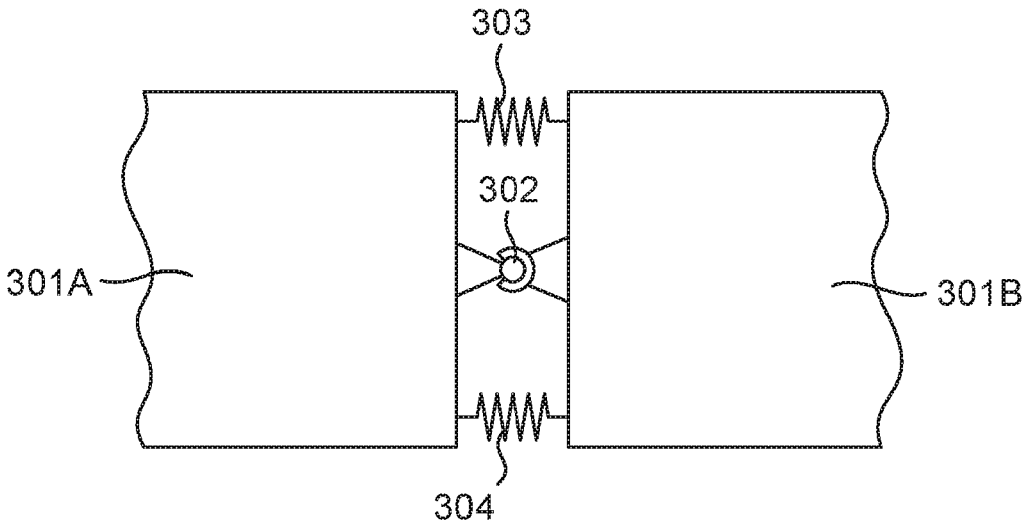

Fig. 4

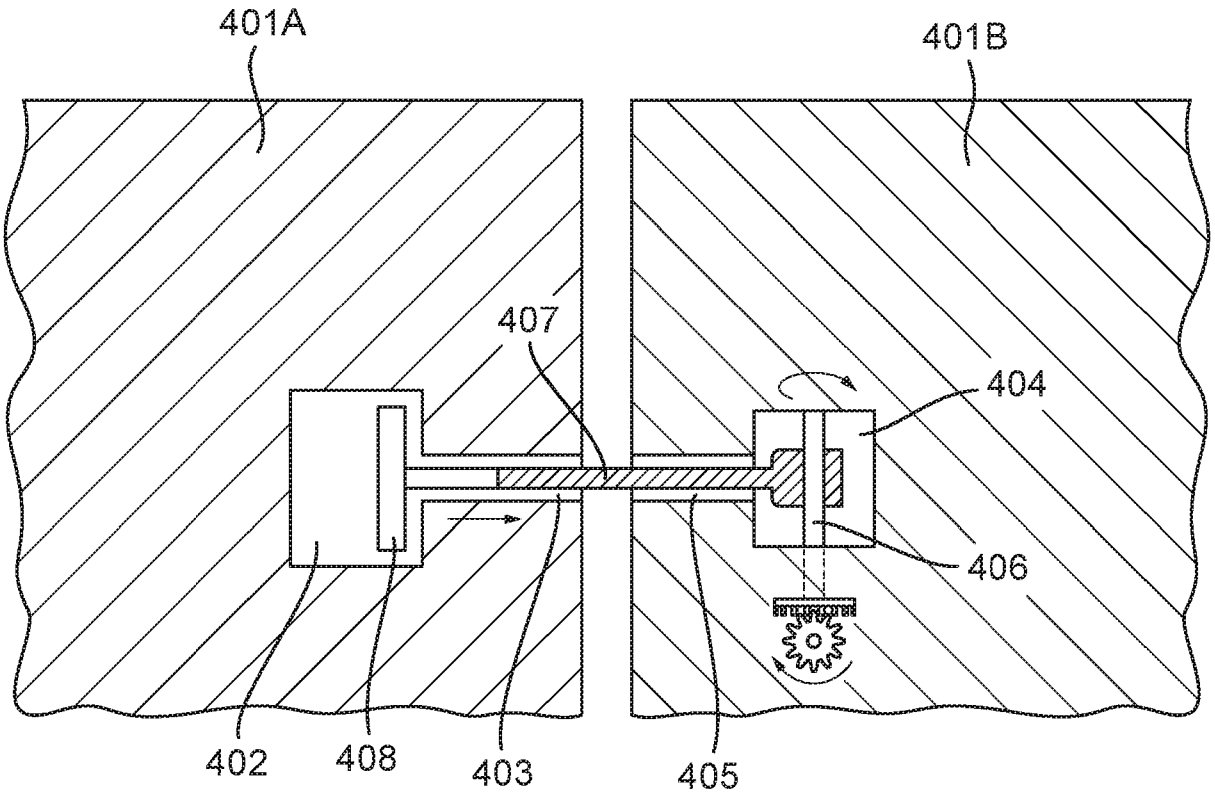

Fig. 5

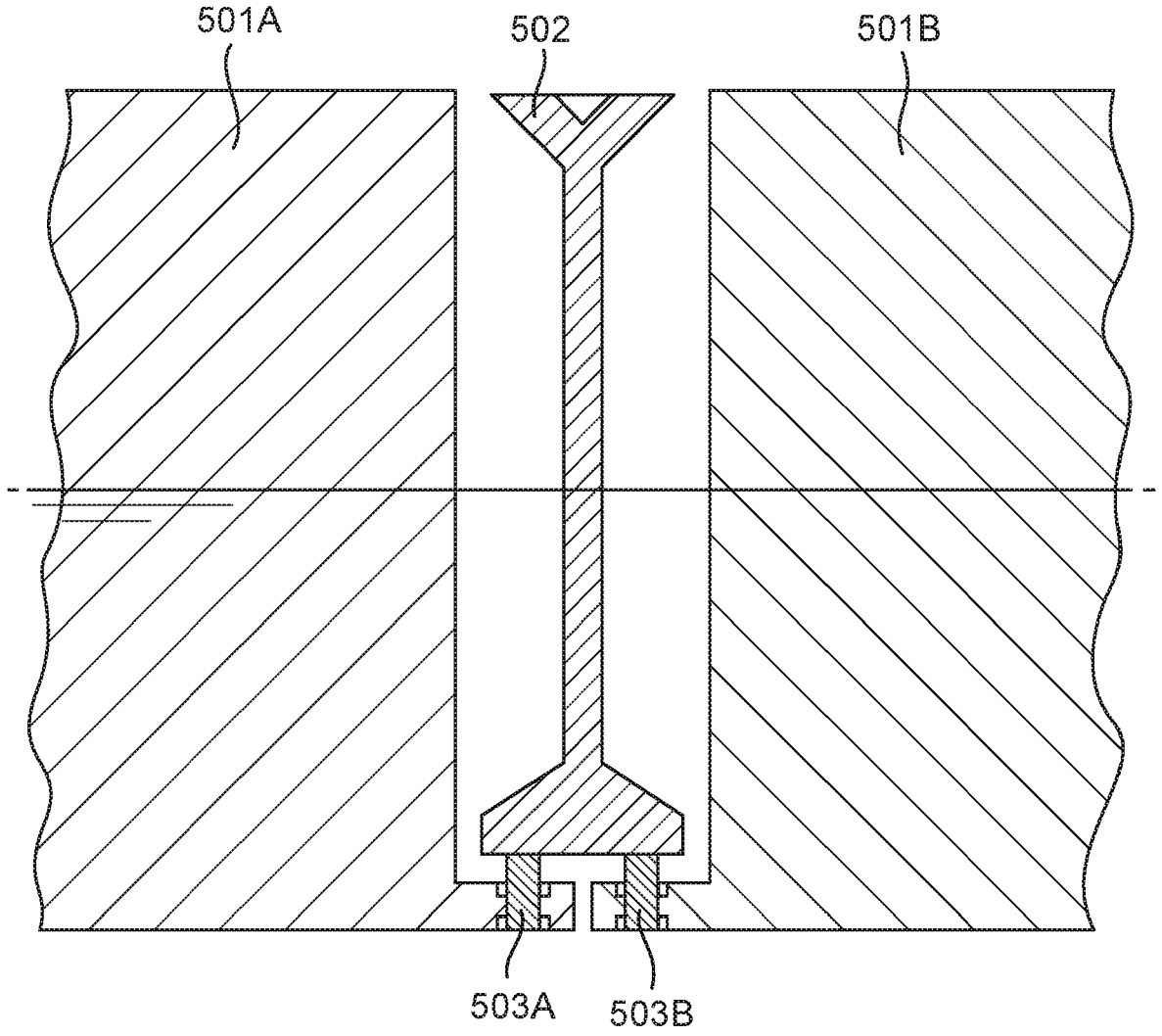

Fig. 6A

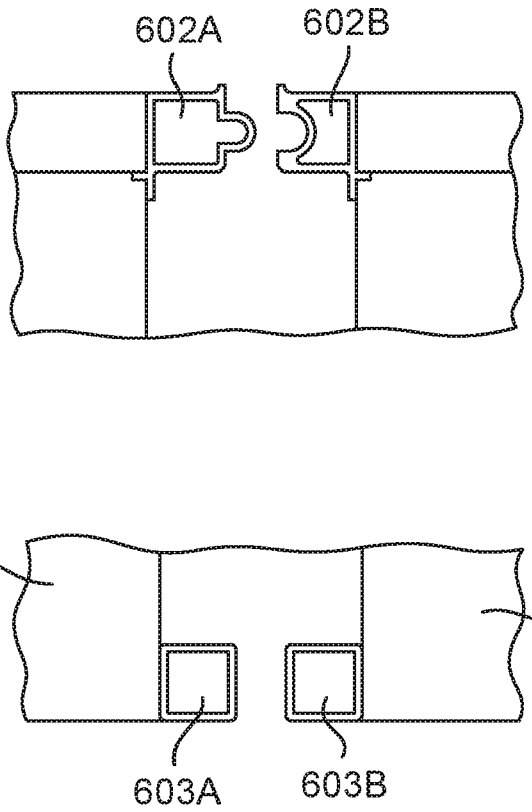

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Fig. 6B

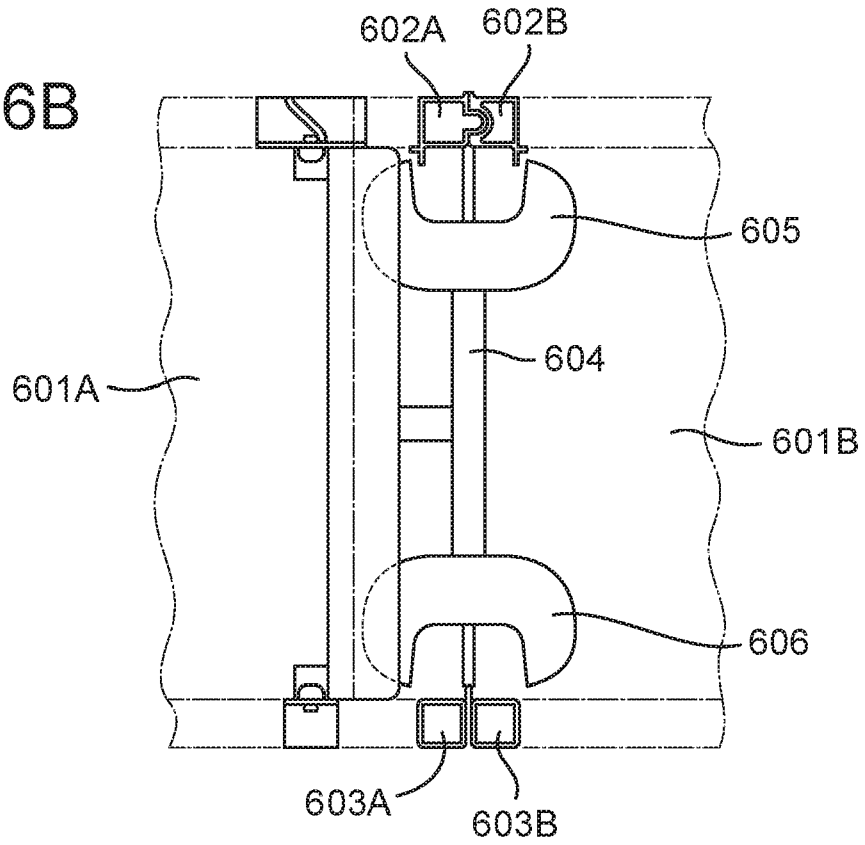

Fig. 7A

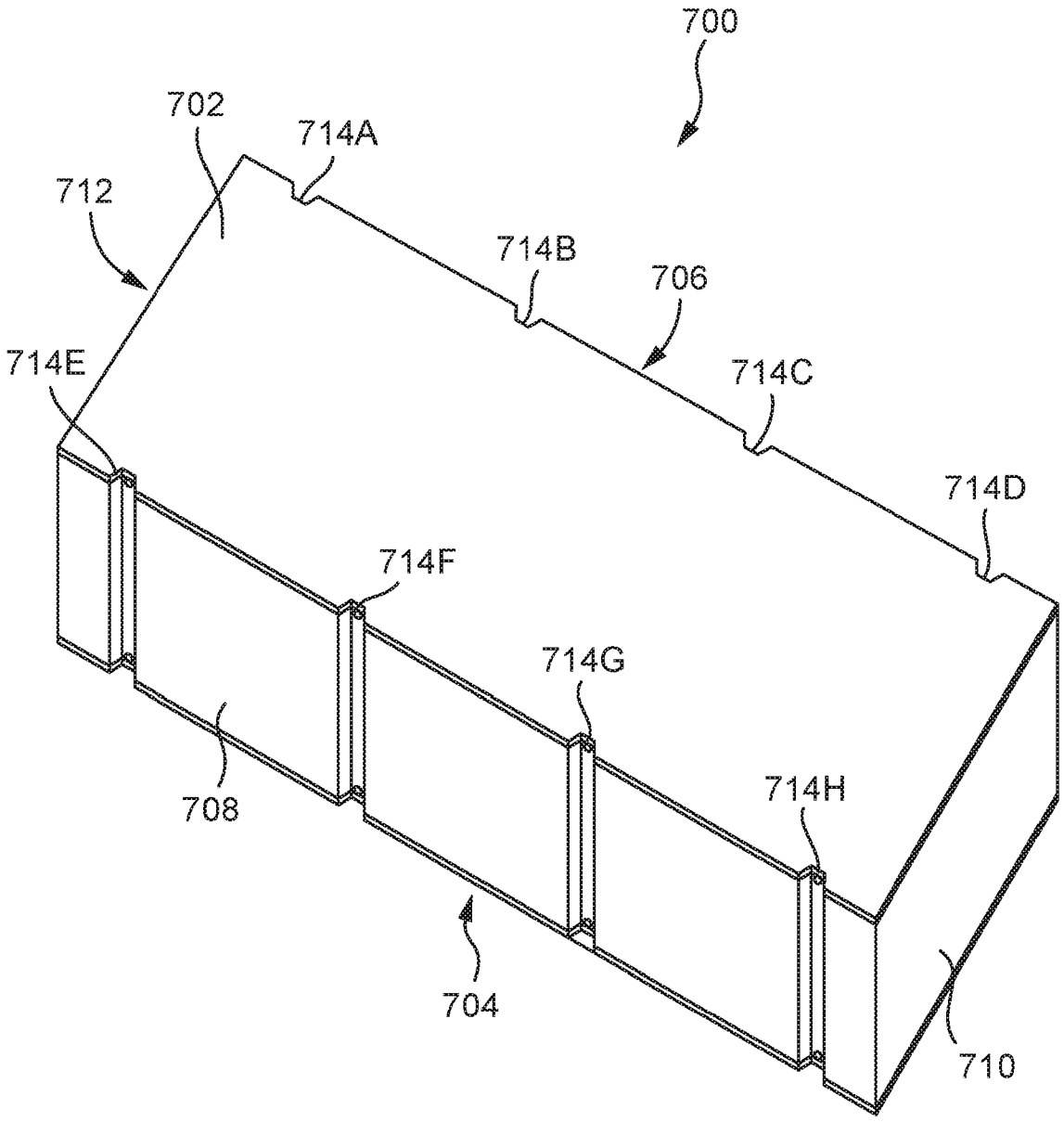

Fig. 7B

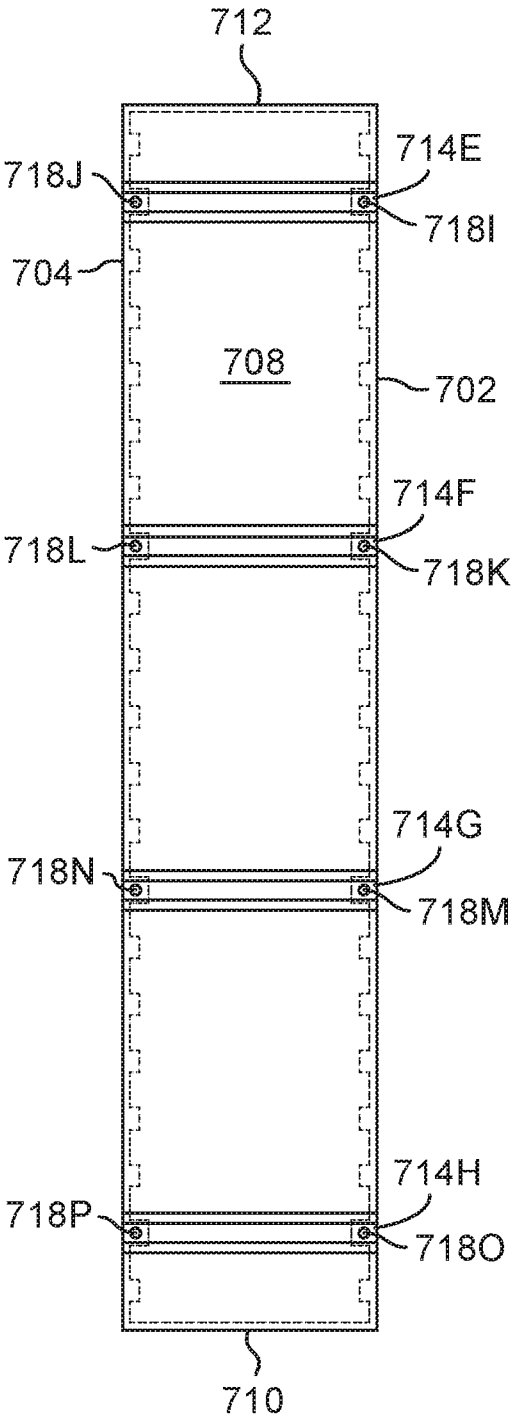

Fig. 7C

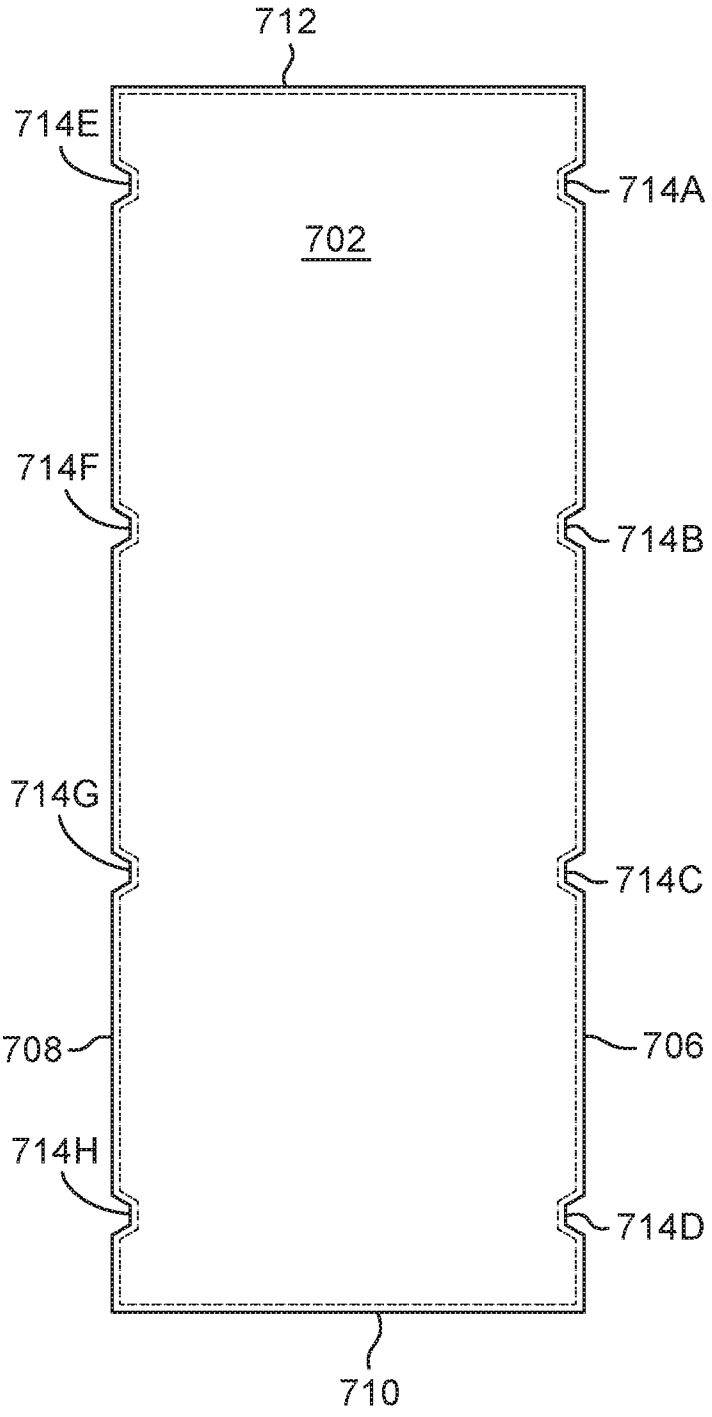

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Fig. 7D

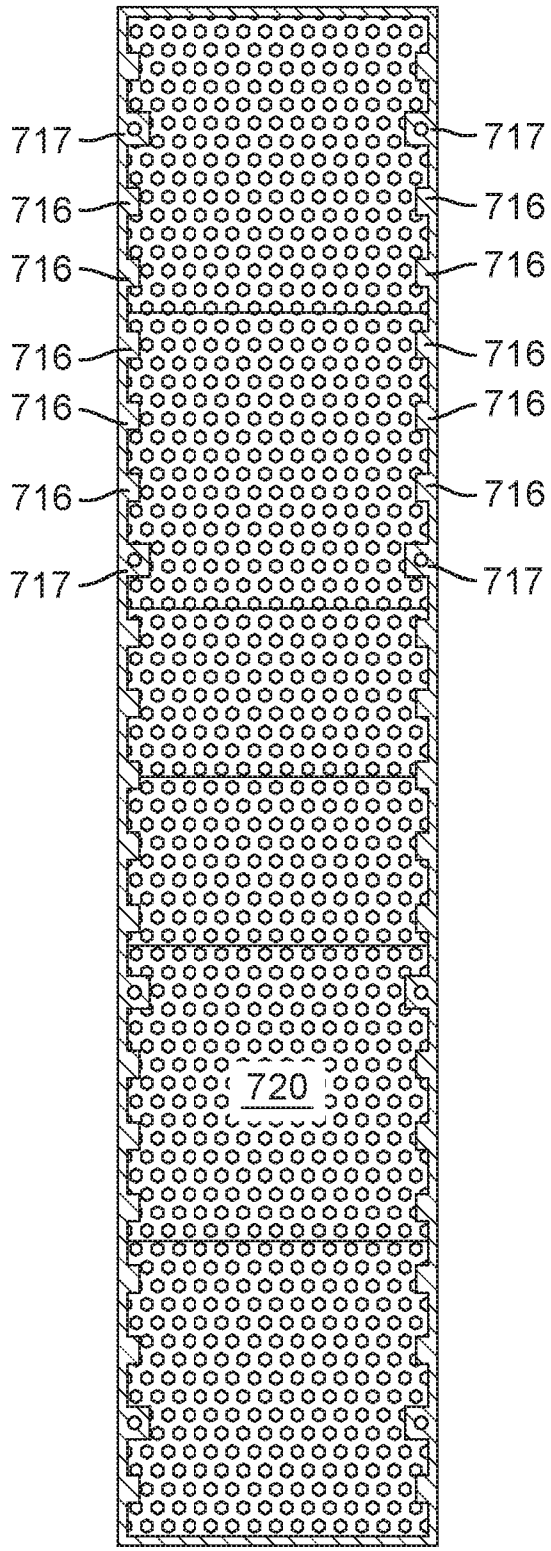

Fig. 7E

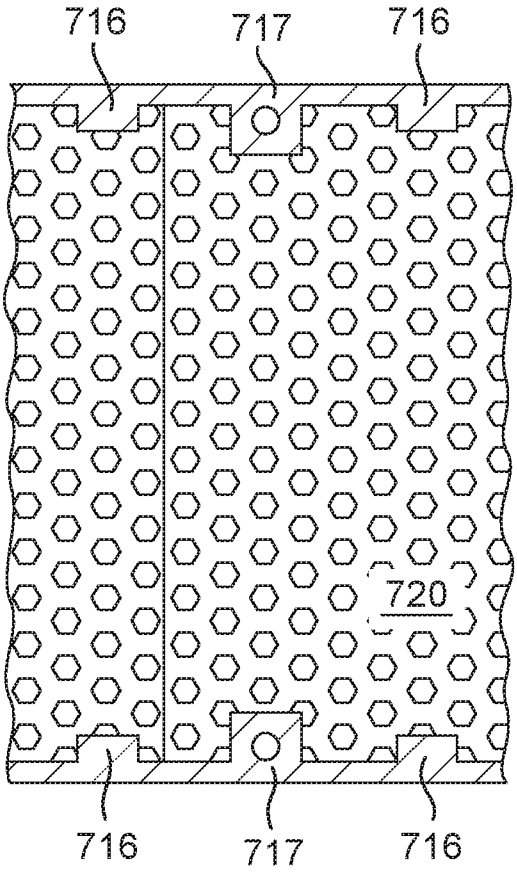

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Fig. 8

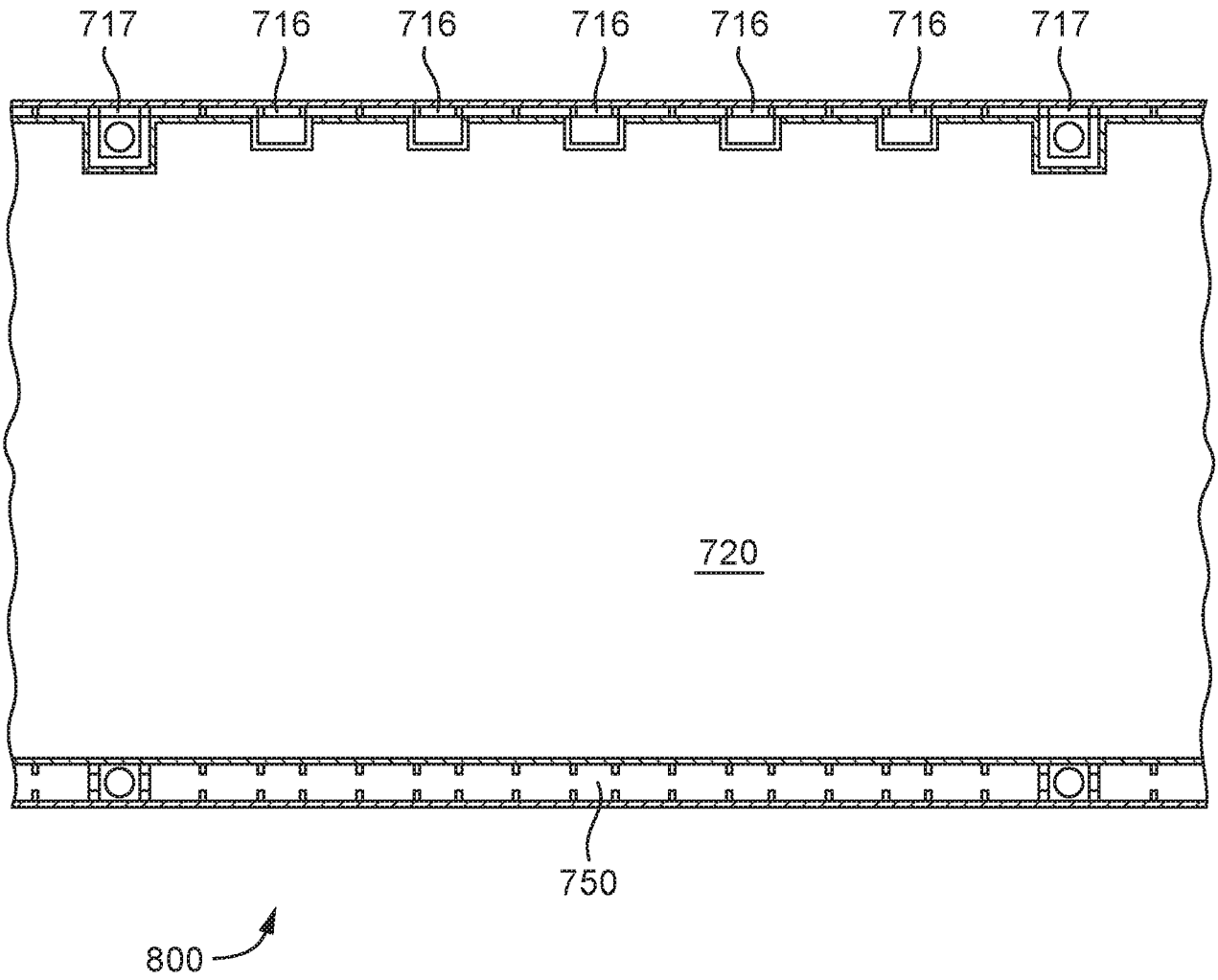

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Fig. 9

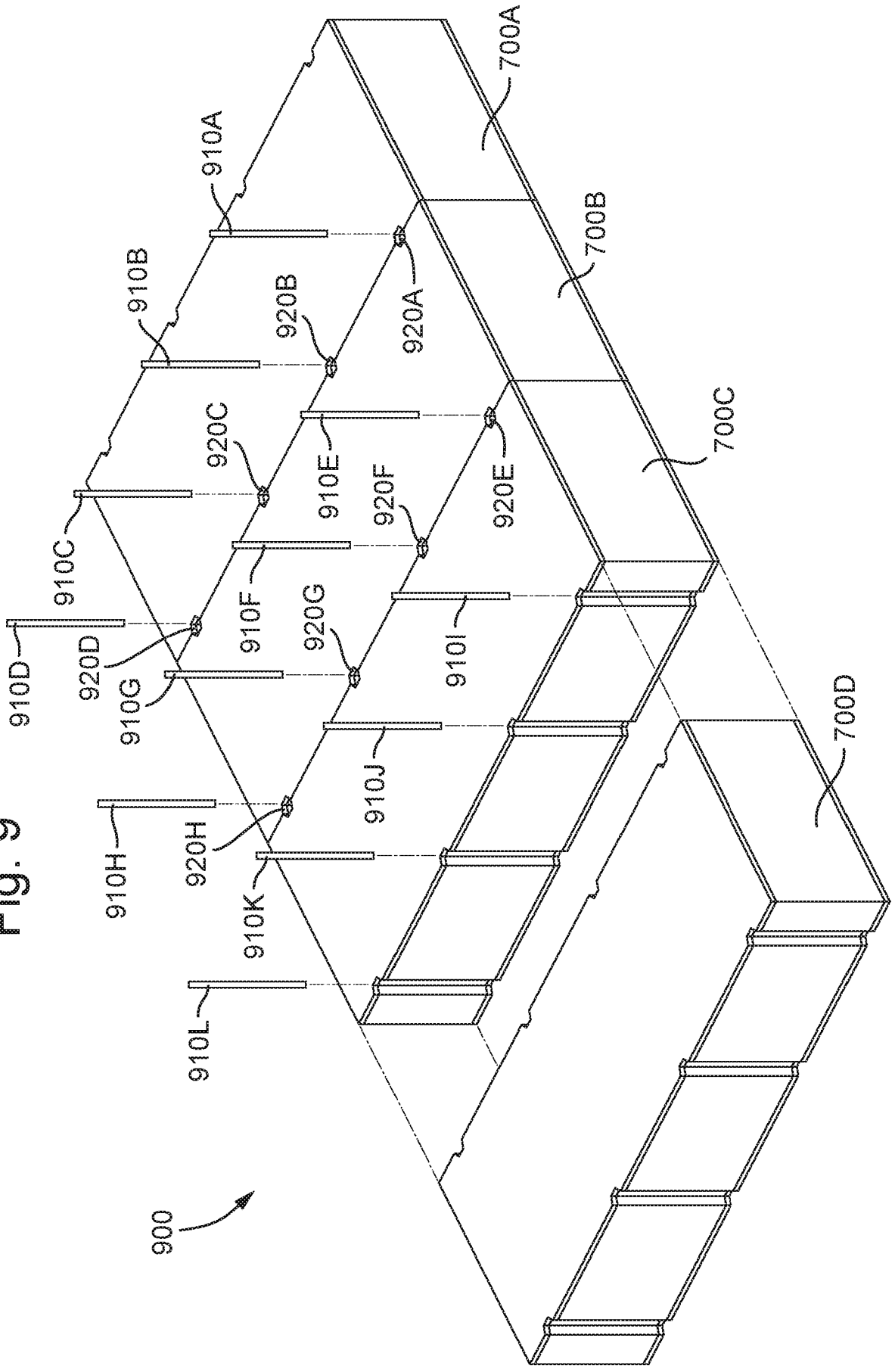
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Fig. 10A

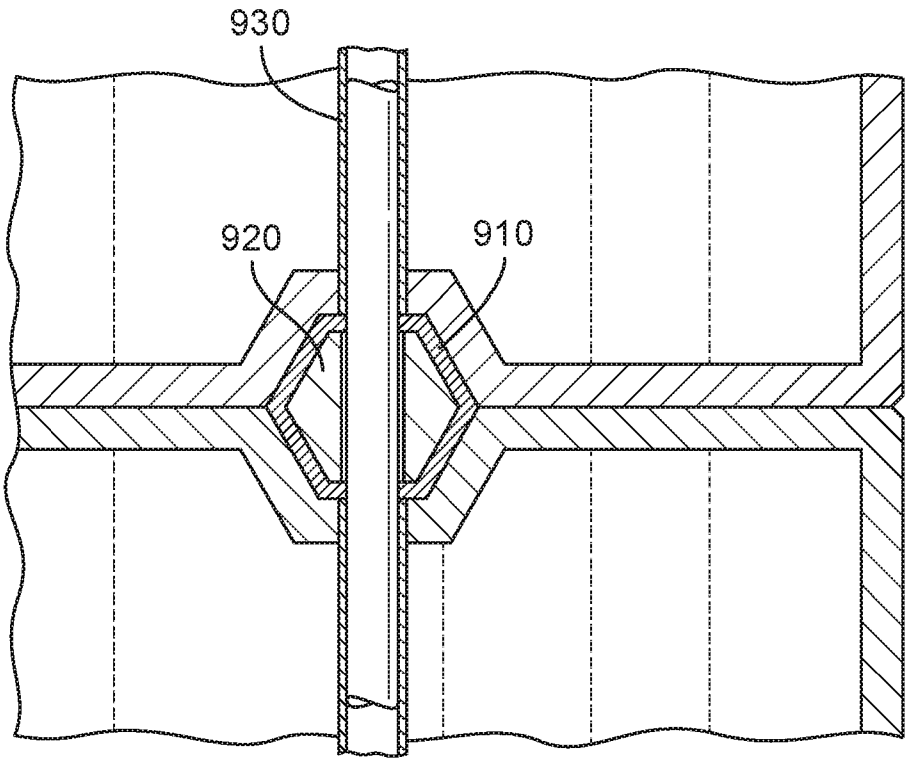


Fig. 10B

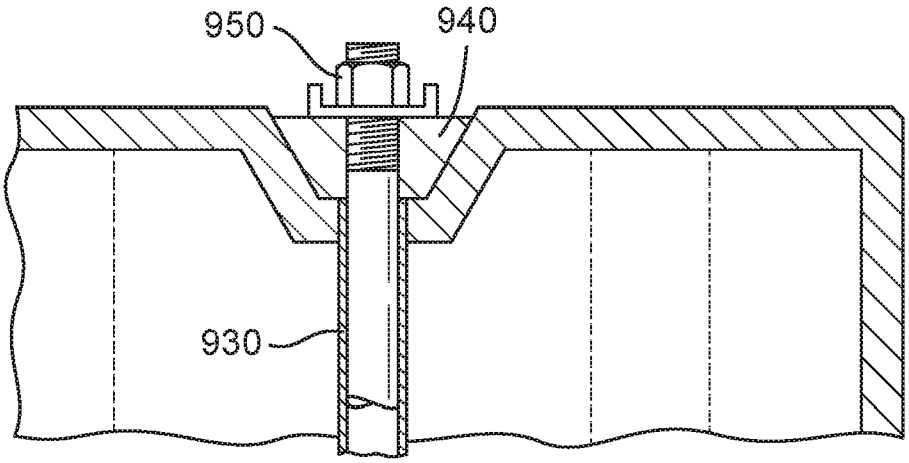


Fig. 11A

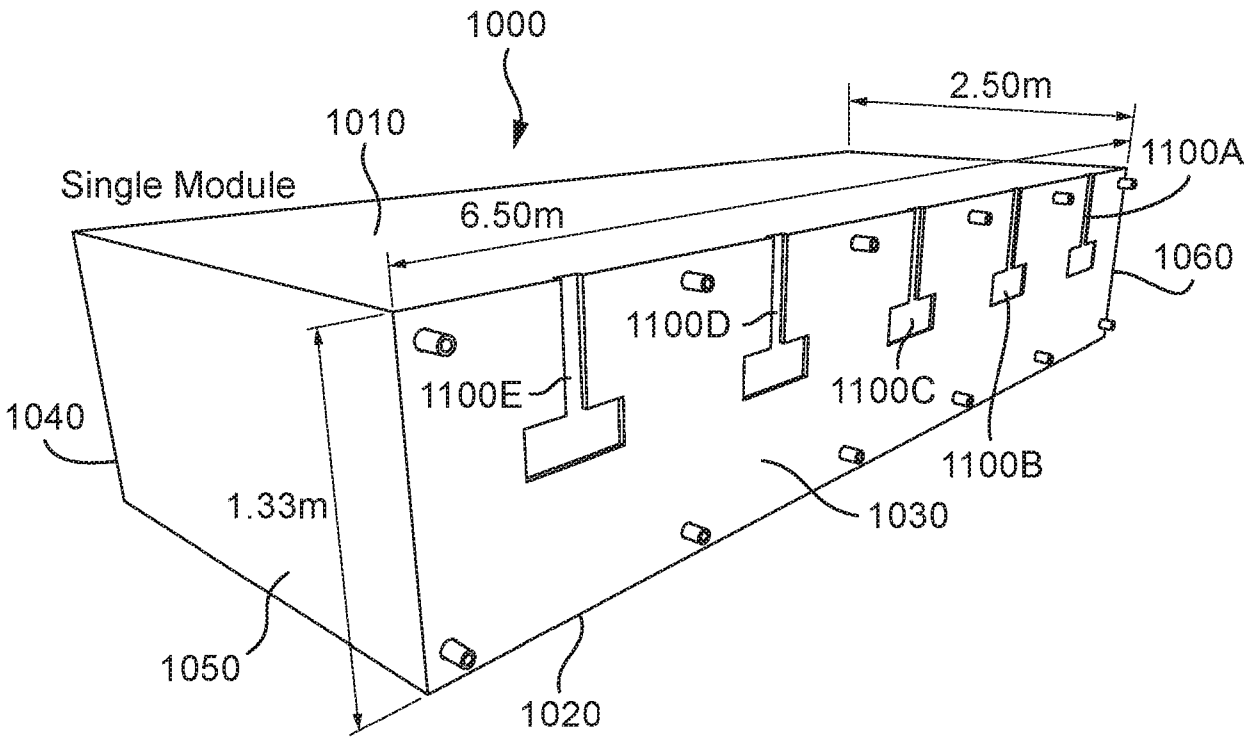


Fig. 11B

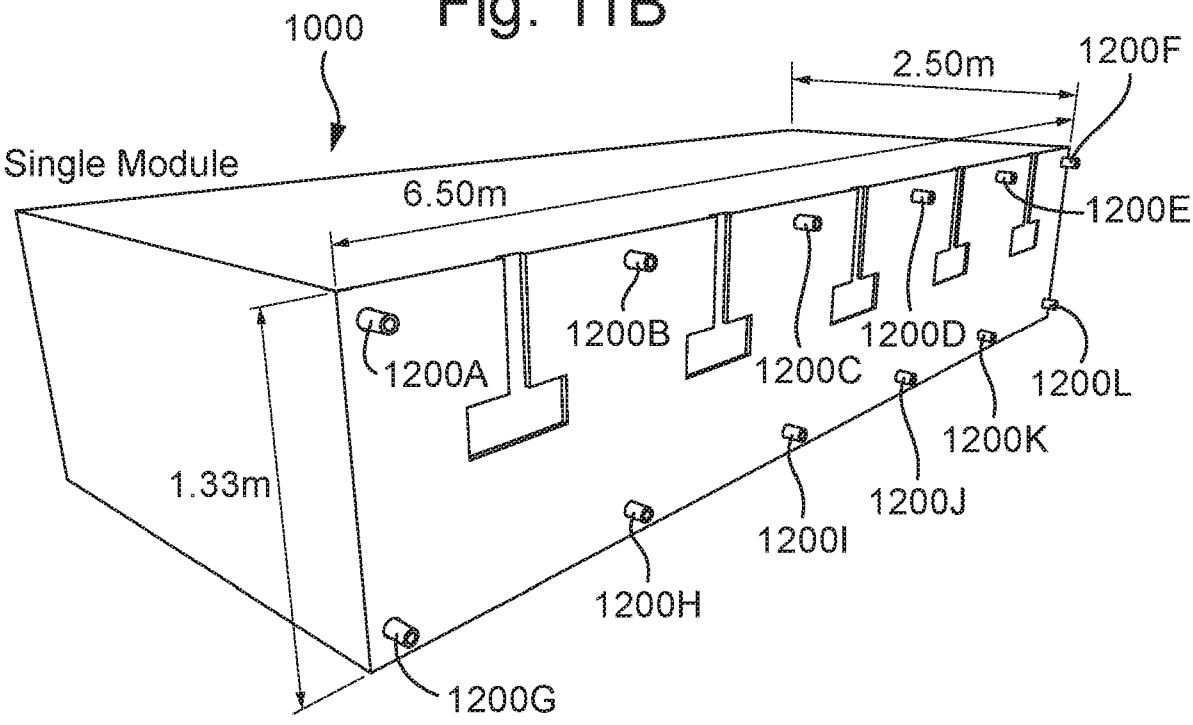


Fig. 11C

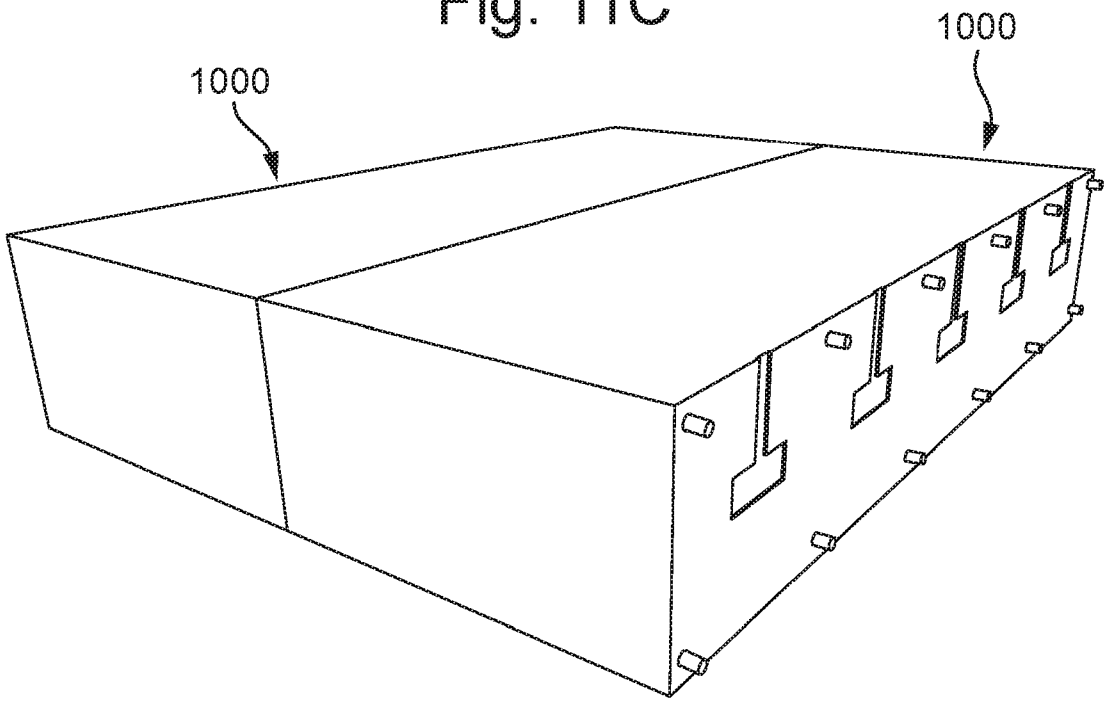
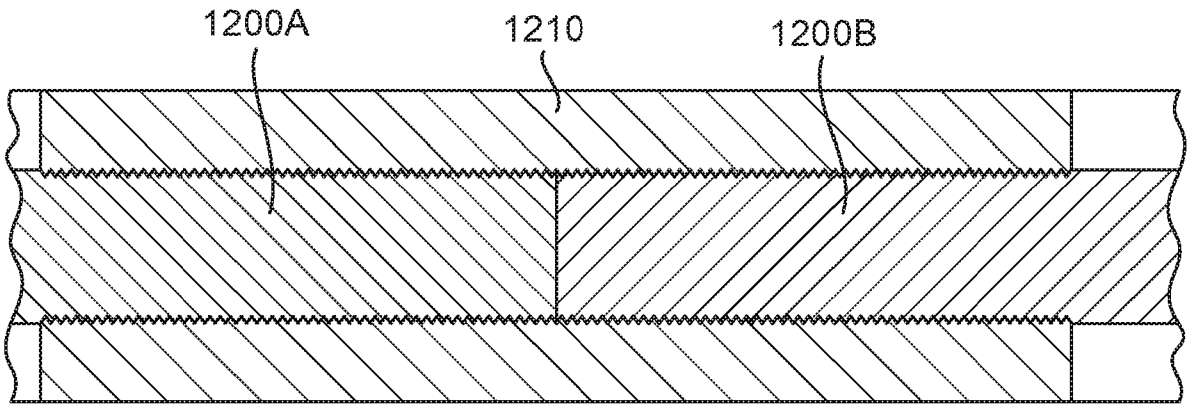


Fig. 11D



A modular concrete floating platform system

Field of invention

The present invention relates to a modular concrete floating platform system.

Background

Figures 1A to 1C illustrate a cross-sectional view of a first pair of prior art floating blocks, a first floating block 101A and a second floating block 101B. The first floating block 101A comprises a projection 102, the projection 102 comprising a vertical aperture 103. The second floating block 101B comprises a horizontal aperture 104 and a pin 105.

To join the first pair of prior art floating blocks, the first floating block 101A is moved into abutment with the second floating block 101B so that the projection 102 of the first floating block 101A enters and is disposed within the horizontal aperture 104 of the second floating block 101B (see Figure 1A and Figure 1B). When the projection 102 of the first floating block 101A is disposed within the horizontal aperture 104 of the second floating block 101B the pin 105 is moved into the vertical aperture 104 of the projection 102 (e.g. by means of a hammer 106). When the pin 105 is disposed in the vertical aperture 104 of the projection 102, the combined system of the pin 105 and the projection 102 is arranged so that the projection can no longer be removed from the horizontal aperture 104 (e.g. the combined system of the projection and the pin is sized so that it cannot pass through the horizontal aperture 104).

A disadvantage of the first pair of prior art floating blocks is that the interlocking system (comprising the projection 102, horizontal aperture 104 and pin 105) is reliant on a high tolerance machined locking system which is expensive.

A disadvantage of the first pair of prior art floating blocks is that if alignment of the pin 105 and the vertical aperture 103 is not plumb (e.g. if there is slight misalignment between the pin and the vertical aperture) then hammering the pin 105 into the vertical aperture 103 can prove to be difficult.

A disadvantage of the first pair of prior art floating blocks is that, from a structural perspective, the vertical aperture has small cross-sectional properties which inherently have a short fatigue life if subjected to wave fatigue loading.

Figure 2 illustrates a cross-sectional view of a second pair of prior art floating blocks, a first floating block 201A and a second floating block 201B. The first floating block 201A comprises a first blind hole 202A, an first edge portion 203A, and a first groove in the edge portion (not shown). The first blind hole 202A and the first groove, when viewed in plan from above (e.g along direction of arrow P) has the shape of the letter `T' (i.e. the combination of the first blind hole 202A and the first groove in the edge portion provide a first T-shaped hole). The second floating block 201B comprises a second blind hole 202B, an second edge portion 203B, and a second groove in the edge portion (not shown). The second blind hole 202B and the second groove, when viewed in plan from above (e.g along direction of arrow P) has the shape of the letter `T' (i.e. the combination of the second blind hole 202B and the second groove in the edge portion provide a second T-shaped hole).

Also provided is a first connecting member 204 and a second connecting member 205. The first connecting member 204 has the form of a letter I with serifs (e.g. `I') or put another way, two capital letter `T's placed bottom to bottom.

To join the second pair of prior art floating blocks, the first floating block 201A is moved into abutment with the second floating block 201B so that the first groove is aligned with the second groove. The first connecting member 204 is disposed within both of the first T-shaped hole and the second T-shaped hole. The second connecting member 205 is disposed within both of the first T-shaped hole and the second T-shaped hole. When the first and second connecting members are disposed in the first and second T-shaped holes, the first floating block 201A cannot be moved out of abutment with the second floating block 201B.

When the first floating block 201A is connected to the second floating block 201B, a small air/water gap exists between the two floating blocks (element G shown in Figure 2). In other words, when connected, the first edge portion 203A and the second edge portion 203B do not directly touch each other.

A disadvantage of the second pair of prior art floating blocks is that it may be difficult to inspect the lower connection (e.g. first connecting member 204) during installation and

service.

A disadvantage of the second pair of prior art floating blocks is that, in the event that the floating blocks are used in a wave environment, the longitudinal strength is reliant solely on the connection provided by first connecting member 204 and the second connecting member 205 because the first edge portion 203A and the second edge portion 203B do not directly touch each other (as shown by gap G). In other words, no support is provided by abutment of the first edge portion 203A of the first block 201A and the second edge portion 203B of the second block 201B. As a result, the first connecting member 204 and the second connecting member 205 which are prone to fatigue wear (low fatigue life) and structural issues.

Figure 3A illustrates a perspective view of a third pair of prior art floating blocks, a first floating block 301A and a second floating block 301B. Figure 3B illustrates a schematic view of the third pair of floating blocks.

The first floating block 301A comprises: a first central coupling means 302A; a first left side coupling means 303A; a first right side coupling means 304A. The second floating block 301B comprises: a second central coupling means 302B; a second left coupling means 304B; a second right coupling means 303B.

The first central coupling means 302A is engageable with the second central coupling means 302B to provide a central coupling means 302. The first left coupling means 303A is engageable with the second right coupling means 303B to provide a first side coupling means 303. The first right coupling means 304A is engageable with the second left coupling means 304B to provide a second side coupling means 304.

To join the third pair of prior art floating blocks, the first floating block 301A is moved into abutment with the second floating block 301B to engage the respect coupling means to thereby provide the central coupling means 302, the first side coupling means 303, and the second side coupling means 304. The central coupling means 302, the first side coupling means 303 and second side coupling means permit relative rotation between the first floating block 301A and the second floating block 301B (e.g. relative rotation of the blocks out of the plane of the page of Figure 3B and rotations with the plane of the page

of Figure 3).

A disadvantage of the third pair of prior art floating blocks is that they have a complex construction and, therefore, may be expensive to manufacture.

A disadvantage of the third pair of prior art floating blocks is that they may be difficult to align during installation which may increase the amount of time and effort required to connect the blocks.

A disadvantage of the third pair of prior art floating blocks is that the coupling means 302, 303 and 304 may be difficult to inspect during service.

Figure 4 illustrates a cross-sectional view of a fourth pair of prior art floating blocks, a first floating block 401A and a second floating block 401B. The first floating block 401A comprises a first cavity 402 connected to an edge of the first floating block by a first hole 403, wherein the first hole 403 has a smaller cross-sectional area than the first cavity 402. The second floating block 401B comprises a second cavity 404 connected to an edge of the second floating block by a second hole 405, wherein the second hole 405 has a smaller cross-sectional area than the second cavity 404.

The second hole 404 comprises a rotatable spool 406 around which is disposed a cable 407. An end of the cable 407 comprises a stopper 408. The cable 407 extends from the rotatable spool 406, via the second hole 405, via the first hole 403, into the first cavity 402. The stopper 408 is disposed in the first cavity 402. The stopper 408 is has a greater cross-sectional area of the hole first 403 so that the stopper 408 cannot be pulled through the first hole and is retained within the first cavity 402.

To join the fourth pair of prior art floating blocks, the spool 406 is rotated to wrap the cable 407 around the spool thereby pulling the stopper 408 towards the second floating blocks 401B. The stopper 408 acts on the first cavity 402 thereby pulling the first floating block 401 towards the second floating block 401B.

A disadvantage of the fourth pair of prior art floating blocks is that the coupling between the block is reliant on the strength of the cable 407 to keep the floating block together.

A disadvantage of the fourth pair of prior art floating blocks is that it may be difficult to apply and/or maintain tension on the cable 407. As a consequence, floating blocks may be unsuitable for long term use (e.g. continuous use of the blocks for a number of days, months or years).

Figure 5 illustrates a cross-sectional view of a fifth pair of prior art floating blocks, a first floating block 501A and a second floating block 501B. The first floating block 501A comprises a first hole 503A. The second floating block 501B comprises a second hole 503B. Also provided is a connecting member 502. The connecting member 502 comprises two projections wherein one of the projections is configured to engage the first hole 503A and the other projection is configured to engage the second hole 503B.

To join the fifth pair of prior art floating blocks, the first floating block 501A is moved into abutment with the second floating block 501B. The connecting member 502 is moved between the first and second floating blocks to thereby engage the projections of the first hole 503A and the second hole 503B. When the projections engage the first and second hole 503 and 503B the first and second blocks cannot be moved out of abutment.

A disadvantage of the fifth pair of prior art floating blocks is that they may be very difficult to align during installation.

A disadvantage of the fifth pair of prior art floating blocks is that the connection between two blocks is reliant on a pair of projections for transferring load between the floating blocks. If the projections are damaged or fail then the connection between the two blocks fails.

A disadvantage of the fifth pair of prior art floating blocks is that inspection of the connection (e.g. the connection provided by connecting member 502 and holes 503A and 503B) cannot be during service unless dismantlement of the connection.

A disadvantage of the fifth pair of prior art floating blocks is that the pair of projections may be susceptible to corrosion and subsequent stress failure.

Figure 6A illustrates a cross-sectional view of a sixth pair of prior art floating blocks, a first floating block 601A and a second floating block 601B in a non-abutting configuration. Figure 6B illustrates a cross-sectional view of the sixth pair of floating blocks, a first floating block 601A and a second floating block 601B in an abutting configuration. The first floating block 601A comprises a first top abutment means 602A with a projection and a first bottom abutments means 603A. The second floating block 601B comprises a second top abutment means 602B with a recess and a second bottom abutments means 603B.

Also provided is a connecting member comprising a shaft 604, a top retaining means 605 and a bottom retaining means 606. The top retaining means 605 is movable along the shaft 604. The bottom retaining means 606 is movable along the shaft 604.

To join the sixth pair of prior art floating blocks, the first floating block 601A is moved into abutment with the second floating block 601B so that: the first top abutment means 602A and the second top abutment means 602B abut one another and so that the projection of the first top abutment means 602A is disposed within the recess of the top abutment means 602B; and, the first bottom abutment means 603A and the second bottom abutment means 603B abut one another. Then the shaft of the connecting member 604 is disposed between the top and bottom abutment means. The top retaining means 605 is moved along the shaft 604 to retain the first top abutment means 602A and the second top abutment means 602B in abutment. The bottom retaining means 606 is moved along the shaft 604 to retain the first top abutment means 602A and the second top abutment means 602B in abutment.

A disadvantage of the sixth pair of prior art floating blocks is that it would be the connection (provided by: the top retaining means 605 and first and second top abutment means 602A & 602B; and, the bottom retaining means 606 and first and second bottom abutment means 603A & 603B) would not be ideal for out-of plane loading (e.g. loading out of the plane of the page), and there would be a risk of structural failure of the connection.

Statement of invention

Aspects of the invention are set out in the independent claims and optional features are set out in the dependent claims. Aspects of the disclosure may be provided in conjunction with each other, and features of one aspect may be applied to other aspects.

An aspect of the invention provides a modular concrete floating platform system comprising a plurality of modular concrete floating blocks and at least one connecting bar; wherein each concrete floating block is filled with a buoyant material and comprises a submerged face configured to be submerged in water, and an exposed face configured to be exposed when the block is floating on water, each block further comprising a pair of opposing sides connecting the submerged face to the exposed face; wherein each of the opposing sides comprises a plurality of recessed notches, wherein each of the plurality of recessed notches comprises at least one lumen extending through the modular concrete floating block from the recessed notch of one opposing side to the recessed notch of the other opposing side for receiving the at least one connecting bar; wherein the system is configured such that the connecting bar is operable to pass through the at least one lumen of a first concrete floating block and through the at least one lumen of a second concrete floating block to couple the first concrete floating block adjacent to the second concrete floating block; wherein the system further comprises: a first fastening means disposed in the recessed notch of a first side of the first concrete floating block on an opposite side of the first concrete floating block to the side of the first concrete floating block adjacent to the second concrete floating block; and a second fastening means disposed in the recessed notch of a second side of the second concrete floating block on an opposite side of the second concrete floating block to the side of the second concrete floating block adjacent to the first concrete floating block; wherein the first fastening means and the second fastening means are configured to fasten the first concrete floating block to the second concrete floating block via the connecting bar passing through both the first concrete floating block and the second concrete floating block.

The system provides a concrete floating platform which may provide a base upon which residential or commercial buildings may be provided. For example, residential houses may be built upon the modular concrete floating platform.

The system provides a concrete platform which may be transported to a given location by road e.g. by a truck comprising a crane.

The modular concrete floating block may be a rectangular cuboid. The rectangular cuboid having a height, H, defined as the shortest distance between the exposed face and the submerged face. The rectangular cuboid having a width, W, defined as the shortest

distance between the first opposing side and the second opposing side. The rectangular cuboid having a length, L, defined as the shortest distance between the first end side and the second end side.

In the examples, the height H, width W, and length L may be selected to so that the modular concrete floating block can fit into the loading area of a truck for transporting the modular concrete floating block. In the examples, the height H, width W, and length L may be selected to so that a plurality of the modular concrete floating blocks can fit into the loading area of a truck for transporting the modular concrete floating block.

In examples, the width W of the modular concrete floating blocks is less than the width of a loading area of a truck for transporting the modular concrete floating blocks.

In examples, the height and the width are each less than the length i.e. H < L; W < L.

In examples, providing a plurality of identical modular concrete floating blocks may thereby permit stacking of the modular concrete floating blocks in the loading bed of a truck. In examples providing a plurality of identical modular concrete floating blocks may permit a greater stacking efficiency of the blocks in a loading volume of loading bed of the truck (e.g. in comparison to blocks with curved faces). Herein the term packing efficiency may be expressed as a percentage defined as:

$$stacking\ efficiency\ \% = \frac{volume\ occupied\ by\ blocks\ in\ loading\ volume}{loading\ volume\ of\ loading\ bed}$$

In examples, a truck described herein may be configured to transfer goods stored in a loading volume of a loading bed by road. The truck may comprise a crane. Advantageously, providing blocks which are transportable by road may allow floating platforms to be provided in otherwise inaccessible locations e.g. in locations not accessible by rail or water.

The modular concrete floating blocks may be formed using casting methods, or using shotcrete methods.

The modular concrete floating platform system may further comprising a column

configured to be inserted into a vertical channel formed when the recessed notch of one concrete floating block abuts the recessed notch of another concrete floating block, the column comprising an opening for the connecting bar to pass therethrough.

Herein the column may be also referred to as a post or a sleeve.

Advantageously, the column may be configured to protect the notches which form the vertical channel from damage. In examples, the column is formed of stainless steel. Advantageously, stainless steel is rigid and is also less brittle than concrete (e.g. C40/50 concrete) which thereby provide a column which may sufficiently prevent damage to the notches and also damage to itself.

In examples, the column may be formed of a reinforced plastic, for example, nylon or polytetrafluoroethylene (e.g. Teflon (RTM)). For example, a reinforced plastic may be selected which is rigid and is also less brittle than concrete (e.g. C40/50 concrete) which thereby provide a column which may sufficiently prevent damage to the notches and also damage to itself.

In examples, the column may be formed of concrete wherein the concrete of the column is less brittle than the concrete of the modular concrete blocks.

The modular concrete floating blocks may comprise recessed notches which have a concave shape.

A column may have a shape which complements the concave shape of the notch to thereby permit the column to be located within the notch.

Each column may have the shape of an annular prism. In examples wherein the notches have a trapezoidal shape to thereby form hexagonal vertical channels, each column has a hexagonal cross-section.

The modular concrete floating blocks may comprise recessed notches or recesses that may be trapezoidal.

In examples, when the recessed notch of one block abuts the recessed notch of another block to form a vertical channel, the vertical channel has a hexagonal cross section.

Advantageously, providing a notch which is trapezoidal prevents the columns from rotating within a vertical channel formed by the notch. Advantageously, providing a notch which is trapezoidal permits a user to insert a column into a vertical channel formed by the notch so that a through hole in the column aligns with (and does not rotate out of alignment with) a lumen in the blocks which form the vertical channel.

Advantageously, providing a notch which is trapezoidal may provide modular concrete floating blocks which, when brought into abutment, are self-aligning. In particular it has been found that notches which a vertical channel with a hexagonal shape is surprisingly good at self-aligning.

In examples, the columns may comprise one or two tapered ends. Advantageously, providing a tapered end may allow the column to be introduced to a channel formed by two notches which are not in complete alignment. Insertion of the tapered column may force the notches into alignment.

For example, when a connecting bar is pushed from a lumen of a first modular concrete floating block toward a lumen of a second modular concrete floating block, the connecting bar may be guided into the lumen of the second modular concrete floating block by the trapezoidal shape of a notch of the second modular concrete floating block. Put another way, angled sides of the trapezoidal notch help to locate connecting bars into a lumen disposed in the notch.

In examples, the notches have a concave shape which may guide a connecting bar into a lumen disposed in the notch.

In examples comprising columns disposed in vertical channels with hexagonal cross-sections formed by abutting two trapezoidal notches, the sides of the column may direct a connecting bar pushed from a lumen of a first modular concrete floating block toward a lumen of a second modular concrete floating block.

Providing trapezoidal notches which form vertical channels with hexagonal cross-sections.

The applicant has found that vertical channels with a hexagonal cross-section are particularly good at reducing movement between neighbouring modular concrete floating blocks shape when the connecting bars are tensioned (e.g. when fastening means are provided on each end of the connecting bar).

The first and second fastening means disposed on each end of a connecting bar connecting a plurality of modular concrete floating blocks may be tightened (e.g. the distance between the first and second fastening means may be reduced) to thereby urge the plurality of modular concrete floating blocks together. Tightening the first and second fastening means in this manner be referred to herein as tensioning the connecting bar.

In examples, a vertical channel is provided with a non-circular cross section (e.g. the notches are not semi-circular in shape). Advantageously, providing a channel with a non-circular cross section prevents the columns from rotating within a channel formed by the notch. Advantageously, providing a vertical channel with a non-circular cross section permits a user to insert a column into a vertical channel formed by the notch so that a through hole in the column aligns with (and does not rotate out of alignment with) a lumen in the blocks which form the vertical channel.

The connecting bar may be a threaded bar, and the fastening means may comprise a threaded nut.

In examples, the connecting bar is formed of a material which is stable (e.g. non-reactive) with water e.g. stainless steel. In examples, the fastening means is formed of a material which is stable (e.g. non-reactive) with water e.g. stainless steel. Advantageously, providing a connecting bar and/or a fastening means which is formed of a material which is stable in the presence of water prevents damage to the connecting bar/fastening means thereby increasing the lifetime of the platform.

The concrete may be reinforced concrete. In examples, the concrete may be reinforced with basalt rebar. In comparison to typical steel rebar which corrodes in the presence of water (e.g. marine water and a salt laden atmosphere), basalt rebar does not corrode. Therefore, using basalt rebar may comparatively increase the lifetime of the platform.

In examples, the recessed notches are lined with at least one of (i) rubber; (ii) stainless steel; and, (iii) a reinforced plastic (for example, a nylon or polytetrafluoroethylene (e.g.Teflon (RTM)). In examples, the rubber and/or stainless steel may be integrally formed with the recessed notches. In examples, the rubber and/or stainless steel may be provided as a column. In examples, the exterior of the column may comprise rubber and the interior of the column may comprise stainless steel.

The buoyant material may comprise expanded polystyrene. In examples, foam work may be provided by expanded polystyrene (e.g. a mould for forming the concrete may be provided by expanded polystyrene). The concrete is subsequently formed around the expanded polystyrene thereby sealing the expanded polystyrene within an internal volume of the concrete. In this way, a modular concrete floating block may be formed using and incorporating the expanded polystyrene which may reduce production costs.

Providing a modular concrete floating block comprising a buoyant material (e.g. expanded polystyrene) may provide a lighter block in comparison to a modular concrete floating block without a buoyant material (e.g. a hollow concrete shell, perhaps comprising air) which may make transportation comparatively easier and/or cheaper (e.g.: less weight on a crane for loading and unloading the blocks from a transportation truck; less fuel required to move the blocks).

Providing a modular concrete floating block comprising a buoyant material (e.g. expanded polystyrene) may provide a more buoyant block in comparison to a modular concrete floating block without a buoyant material (e.g. a hollow concrete shell, perhaps comprising air) which may allow greater loads (e.g. weights) to be disposed on the former than the latter.

When at least two concrete floating blocks are coupled together with a connecting bar, the recessed notches between the adjacent concrete floating blocks may be filled with grout. Advantageously, the blocks may be bonded in place with the grout which may increase the lifetime of the platform.

An aspect of the disclosure provides a concrete floating platform block for use with a modular concrete floating platform system; wherein the modular concrete floating block is

filled with a buoyant material and comprises a submerged face configured to be submerged in water, and an exposed face configured to be exposed when the block is floating on water, each block further comprising a pair of opposing sides connecting the submerged face to the exposed face; wherein each of the opposing sides comprises a plurality of recessed notches, wherein each of the plurality of recessed notches comprises at least one lumen extending through the modular concrete floating block from the recessed notch of one opposing side to the recessed notch of the other opposing side for receiving a connecting bar; wherein the system is configured such that the connecting bar is operable to pass through the at least one lumen of a first concrete floating block and through the at least one lumen of a second concrete floating block to couple the first concrete floating block adjacent to the second concrete floating block.

An aspect of the disclosure provides a method of forming a floating concrete platform from a plurality of modular concrete blocks, the method comprising: (i) abutting a pair of the modular concrete floating blocks, the pair comprising a first opposing side of a first modular concrete floating block to a second opposing side of a second modular concrete floating block, so that notches on the first opposing side of the first modular concrete floating block and the second opposing side of the second modular concrete floating block abut and align to thereby form one or more vertical channels; (ii) inserting a connecting bar through a lumen in the first modular concrete floating block and a lumen in the second modular concrete floating block; (iii) repeating steps (i) to (ii) to provide a unitary platform wherein all of the plurality of modular concrete floating blocks is abutted with at least one other modular concrete floating block, thereby providing two end modular concrete floating blocks wherein each modular concrete floating block has an outward-facing side comprising outward-facing notches; (iv) attaching a fastening means to ends of connecting bars which protrude from the outward-facing notches to thereby prevent the modular concrete floating blocks from moving out of abutment with one another and to thereby prevent the connecting bar from exiting any of the lumens.

In examples, the modular concrete floating blocks may comprise integral fastening means (e.g. female threaded portions disposed in the lumens). In such examples, step (ii) is instead: inserting a connecting bar through a lumen in the first modular concrete floating block and a lumen in the second modular concrete floating block and securing the connecting bar to at least one of the modular concrete floating blocks using a fastening

means integral to the block; and also, step (iv) is dispensed with.

The method may further comprise, before step (ii), a step of inserting a column into each of the vertical channels.

The method may further comprise a step of: applying grouting between abutting modular concrete floating blocks to thereby adhere the abutting modular concrete floating blocks.

It will be appreciated that in some examples the lumens need not be provided in the recessed notches but may instead be located elsewhere on the concrete floating block. For example, the lumens may be interspersed (e.g., interdigitated) between recessed notches.

It will also be appreciated that in some examples instead of each concrete floating block comprising recessed notches, each concrete floating block may comprise recesses that that take another shape, for example that form a T-shape when viewed in plan view. When two such recesses are abutted against each other they may form a void that may be filled with grout to form a rigid connection or join between the two concrete floating blocks that may advantageously resist shear and/or torsional forces between the neighbouring floating bricks thereby providing a stable modular concrete floating platform.

Accordingly, another aspect of the disclosure provides a modular concrete floating platform system comprising a plurality of concrete floating blocks; wherein each concrete floating block is filled with a buoyant material and comprises a submerged face configured to be submerged in water, and an exposed face configured to be exposed when the block is floating on water, each block further comprising a pair of opposing sides connecting the submerged face to the exposed face; wherein each of the opposing sides comprises a plurality of recesses and a plurality of lumens for receiving respective connecting bars to couple a first concrete floating block adjacent to a second concrete floating block, wherein the recesses on an opposing side of the first concrete floating block abut and align with the recesses on an opposing side of the second concrete floating block to thereby form a plurality of voids between the adjacent concrete floating blocks, and wherein the plurality of voids between adjacent concrete floating blocks are filled with grout.

The system provides a concrete floating platform which may provide a base upon which residential or commercial buildings may be provided. For example, residential houses may be built upon the modular concrete floating platform.

In some examples, each concrete floating block may comprise its own connecting bars to connect to corresponding connecting bars of another concrete floating block. For example, each of the connecting bars of a first concrete floating block may be connectable to a corresponding connecting bar of a second concrete floating block by means of an intermediate coupling element e.g., a coupler. The coupler may be configured to couple a connecting bar of a first concrete floating block to a connecting bar of a second concrete floating block.

However, in other examples only one concrete floating block of a pair may comprise connecting bars to couple the two concrete floating blocks together – for example, by mating with corresponding threaded portions of the respective lumens on each of the two concrete floating blocks. In other examples a connecting bar may be configured to couple a plurality of concrete floating blocks together, e.g., if the connecting bar is long enough to pass through at least the whole width of a concrete floating block.

The connecting bars may be connectable by any of a screw fit (e.g. with corresponding male and female threads on respective connecting bars or separate couplers) and/or an interference fit.

For example, the connecting bars of a first concrete floating block may comprise a male threaded portion and the connecting bars of a second concrete floating block may comprise a male threaded portion and the coupler may comprise a female threaded portion. In such examples, the two male threaded portions of the connecting bars are threaded into the coupler to thereby engage the female threaded portions thereby coupling adjacent blocks together.

In examples, the recesses comprise blind channels e.g. grooves which have an open end at one of the faces of floating concrete blocks.

The system provides a concrete platform which may be transported to a given location by road e.g. by a truck comprising a crane.

The recesses of each concrete floating block may be T-shaped, but it will be appreciated that the recesses may have other geometries such as an L-shape. The voids formed by abutting and aligning two recesses may be T-shaped. In examples, liquid grout poured into said voids adopts the same shape as the voids. When the grout sets, a solid grout member is provided with the shape of the voids. Correspondingly a T-shaped body of grout is provided between the adjacent floating concrete blocks to prevent the blocks moving apart. Furthermore, advantageously, the T-shaped body of grout may resist shear and/or torsional forces between the neighbouring floating blocks thereby providing a stable modular concrete floating platform. Moreover, given the relatively simple geometry of the T-shaped recesses, the effort and cost to manufacture said concrete floating blocks (e.g. by providing a mould and pouring concrete therein) may be reduced.

The concrete floating blocks may be formed of concrete which is reinforced concrete. The concrete may be reinforced with basalt rebar.

The concrete floating blocks may comprise a buoyant material which comprises expanded polystyrene.

An aspect of the disclosure provides a concrete floating block for use with a modular concrete floating platform system; wherein the concrete floating block is filled with a buoyant material and comprises a submerged face configured to be submerged in water, and an exposed face configured to be exposed when the block is floating on water, each block further comprising a pair of opposing sides connecting the submerged face to the exposed face; wherein each of the opposing sides comprises a plurality of recesses and a plurality of connecting bars connected with couplers, wherein each of the connecting bars of the concrete floating block is connectable to a corresponding connecting bar of another concrete floating block to couple the concrete floating block adjacent to the other concrete floating block, wherein when the concrete floating block is connected and adjacent to another concrete floating block the recesses on an opposing side of the concrete floating block abut recesses on an opposing side of the other concrete floating block to thereby form a plurality voids between the concrete floating block and the other

concrete floating blocks, wherein when at least two said concrete floating blocks are coupled together with the one or more connecting bars and couplers, the plurality of voids between adjacent concrete floating blocks are filled with grout.

An aspect of the disclosure provides a method of forming a modular concrete floating platform from a plurality of concrete blocks, the method comprising: (i) connecting a first concrete floating block with a second concrete floating block, so that connecting bars on a first opposing side of the first concrete floating block connect to connecting bars with couplers on a second opposing side of the second concrete floating block, so that recesses on the first opposing side of the first concrete floating block abut and align with respective recesses in the second opposing side of the second concrete floating block to thereby form voids; (ii) applying grouting in the voids to thereby adhere the connected concrete floating blocks to provide a modular concrete floating platform.

In examples, the voids may therefore be T-shaped. In other examples, however, for example where the recesses are L-shaped, I voids may alternatively have a corresponding L-shape. It will be appreciated that other shapes, for example other trapezoidal shapes, may also be considered.

Drawings

Embodiments of the disclosure will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figures 1A to 1C illustrate a cross-sectional view of a first pair of prior art floating blocks (described above);

Figure 2 illustrates a cross-sectional view of a second pair of prior art floating blocks (described above);

Figure 3A illustrates a perspective view of a third pair of prior art floating blocks (described above);

Figure 3B illustrates a schematic view of the third pair of prior art floating blocks (described above);

Figure 4 illustrates a cross-sectional view of a fourth pair of prior art floating blocks (described above);

Figure 5 illustrates a cross-sectional view of a fifth pair of prior art floating blocks (described

above);

Figure 6A illustrates a cross-sectional view of a sixth pair of prior art floating blocks wherein a first floating block and a second floating block are in a non-abutting configuration (described above);

Figure 6B illustrates a cross-sectional view of the sixth pair of prior art floating blocks wherein a first floating block and a second floating block are in an abutting configuration (described above);

Figure 7A illustrates a perspective view of a modular concrete floating block;

Figure 7B illustrates a transparent plan side view of the modular concrete floating block;

Figure 7C illustrates a place top view of the modular concrete floating block;

Figure 7D illustrates a cross-sectional view of the modular concrete floating block illustrated in Figure 7B;

Figure 7E illustrates a portion of the cross-sectional view of the modular concrete floating block illustrated in Figure 7A;

Figure 8 illustrates a side cross-sectional view of an alternative modular concrete floating block;

Figure 9 illustrates a perspective view of a modular concrete floating platform system;

Figure 10A illustrates a transparent top plan view of a first portion of the modular concrete floating platform system;

Figure 10B illustrates a transparent top plan view of a second portion of the modular concrete floating platform system;

Figures 11A and 11B illustrate a perspective view of a concrete floating block;

Figure 11C illustrates a perspective view of concrete floating platform comprising two concrete flocking blocks;

Figure 11D illustrates a plan view of a pair of connecting bars and a coupler.

Specific description

Figure 7A illustrates a perspective view of a modular concrete floating block; Figure 7B illustrates a transparent plan side view of the modular concrete floating block; Figure 7C illustrates a place top view of the modular concrete floating block. Figure 7D illustrates a cross-sectional view of the modular concrete floating block illustrated in Figure 7B. Figure 7E illustrates a portion of the cross-sectional view of the modular concrete floating block illustrated in Figure 7A.

The modular concrete floating block 700 comprises: an exposed face 702; a submerged face 704; a first opposing side 706; a second opposing side 708; a first end side 710; a second end side 712; a plurality of recessed notches 714A to 714H; a plurality of short reinforcement ribs 716; a plurality of tall reinforcement ribs 717; a plurality of lumens 718I to 718P.

The modular concrete floating block 700 is rectangular cuboid. The exposed face 702 is disposed opposite the submerged face 704. The first opposing side 706 is disposed opposite the second opposing side 708. The first end side 710 is disposed opposite the second end side 712. The exposed face 702 and the submerged face 704 are connected to the first opposing side 706. The exposed face 702 and the submerged face 704 are connected to the second opposing side 708. The exposed face 702 and the submerged face 704 are connected to the first end side 710. The exposed face 702 and the submerged face 704 are connected to the second end side 712. The first opposing side 706 and the second opposing side 708 are connected to the first end side 710. The first opposing side 706 and the second opposing side 708 are connected to the second end side 712. The exposed face 702, the submerged face 704, the first opposing side 706, the second opposing side 708, the first end side 710 and, the second end side 712 delimit an internal volume 720 of the modular concrete floating block 700.

The modular concrete floating block may be a rectangular cuboid. The rectangular cuboid having a height, H, defined as the shortest distance between the exposed face and the submerged face. A height axis is defined by a straight line connecting the exposed face and the submerged face. The rectangular cuboid having a width, W, defined as the shortest distance between the first opposing side and the second opposing side. A width axis is defined by a straight line connecting the first opposing side and the second opposing side. The rectangular cuboid having a length, L, defined as the shortest distance between the first end side and the second end side. A length axis is defined by a straight line connecting the first end side and the second end side. The width axis, height axis and length axis are mutually orthogonal.

The internal volume 720 of the modular concrete floating block 700 contains a buoyant material. In other words, type and amount of the buoyant material is selected to provide a combined system (e.g. the modular concrete floating block (excluding the buoyant

material) and the buoyant material) which is buoyant in fresh water and/or salt water.

The buoyant material has a density less than the density of water (e.g. at a given temperature and pressure such as, 273 K and 101 kPa). In examples, the buoyant material may be: expanded polystyrene.

Advantageously, expanded polystyrene may provide formwork around which the concrete sides and faces of the modular concrete floating blocks thereby saving time and expenditure when manufacturing the modular concrete floating blocks.

Advantageously, providing expanded polystyrene in the internal volume of the modular concrete floating block may thereby provide a barrier to prevent ingress of water into the internal volume.

In examples, the modular concrete floating block is provided with the buoyant material disposed within the internal volume. Advantageously, the modular concrete floating blocks may be easier to use (e.g. the modular concrete floating blocks are ready to use without the need to provide buoyant material).

In examples, the modular concrete floating block is provided without the buoyant material disposed within the internal volume. In such examples, a sealable orifice is provided in the block (e.g. in any of the exposed face, submerged face, or any of the sides) configured to permit a suitable buoyant material to be introduced to the internal volume. Advantageously, the mass of the modular concrete floating block (e.g. the mass of the modular concrete floating block without the buoyant material) is reduced in comparison to the mass of a modular concrete floating block with the buoyant material. As a result, transportation of modular concrete floating block without the buoyant material may be easier and/or cheaper than transportation of a modular concrete floating block with the buoyant material (e.g.: less weight on a crane for loading and unloading the blocks from a transportation truck; less fuel required to move the blocks).

The modular concrete floating blocks (excluding the buoyant material) are formed of concrete. In the example shown in Figures 7A, 7B, 7C, 7E, 7F, 8, the concrete is C40/50. C40/50 concrete has the following properties:

- Target strength 40N/mm2 cylinder and 50 N/mm2 cube strength
- Max aggregate size 3.5 mm
- Cement 480 kgm^{-3}
- Aggregate 1000 kgm^{-3}
- Sand 650 kgm^{-3}
- Water 220 kgm^{-3}
- Water proofing admixture (e.g. Xypex(RTM) or Pudlo (RTM) cement water proof powder) 2.5 kgm^{-3}

A particular advantage with forming the modular concrete floating blocks from C40/50 concrete is that the exposed face 702, submerged face 704, first opposing side 706, second opposing side 708, first end side 710, and second end side 720 to be formed with a smaller thickness than if other concretes were used whilst still providing sufficient strength for the modular concrete floating block. A result of this, in comparison to an modular concrete floating block formed of a concrete other than C40/50, a modular concrete floating block formed of C40/50 concrete may be comparatively lighter, require a comparatively lesser amount of concrete (e.g. thereby reducing the comparative cost of manufacturing the modular concrete floating blocks), comparatively reduce the amount of buoyant material required, and the make transportation comparatively easier and/or cheaper (e.g.: less weight on a crane for loading and unloading the blocks from a transportation truck; less fuel required to move the blocks).

In examples, the concrete may be reinforced concrete, for example, reinforced with basalt rebar.

In examples, the concrete may be any other type of concrete e.g. not C40/50.

The plurality of recessed notches 714A to 714D are disposed in the first opposing side 706. The plurality of recessed notches 714E to 714H are disposed in the second opposing side 708. Each of the plurality of recessed notches 714A to 714D disposed in the first opposing side 706 is disposed opposite one of the plurality of recessed notches 714E to 714H disposed in the second opposing side 708 e.g. to provide opposing pairs of recessed notches. Recessed notch 714A is disposed opposite recessed notch 714E e.g. to thereby provide recessed notch pair AE. Recessed notch 714B is disposed opposite recessed

notch 714F e.g. to thereby provide recessed notch pair BF. Recessed notch 714C is disposed opposite recessed notch 714G e.g. to thereby provide recessed notch pair CG. Recessed notch 714D is disposed opposite recessed notch 714H e.g. to thereby provide recessed notch pair DH.

Each of the recessed notches 714A to 714H has a trapezoidal shape. In other words, when viewing the exposed face 702 in plan, the recessed notches 714A to 714H have the shape of an equilateral trapezium (e.g. the non-parallel sides and the short parallel side of the trapezium have equal lengths) wherein the short parallel sides of a recessed notch pair is closer than the long parallel sides of a recessed notch pair. The trapezoidal shape is constant through each recessed notch e.g. each recessed notch has the same cross sectional shape (an equilateral trapezium) throughout the recessed notch.

Two modular concrete floating blocks 700 are abutted such that a recessed notch on a first of the modular concrete floating block and a recessed notch on a second modular concrete floating block forms a vertical channel. Viewing the exposed face of the blocks in plan, the vertical channel has a regular hexagonal shape. The hexagonal shape is constant through each vertical channel e.g. each vertical channel has the same cross sectional shape (a regular hexagon) throughout the vertical channel. Put another way each vertical channel is a channel aligned parallel to the height axis of the modular concrete floating blocks.

The plurality of tall reinforcement ribs 717 are disposed in the internal volume 720 of the modular concrete floating block 700. Four of the tall reinforcement ribs 717 are connected to the exposed face 702 and another four of the tall reinforcement ribs 717 are connected to the submerged face 704. Each of the tall reinforcement ribs 717 is disposed between one of the recessed notch pairs. Each of the recessed notch pairs has a first tall reinforcement rib 717 disposed therebetween which is connected to the exposed face 702 and a second reinforcement rib 717 disposed therebetween which is connected to the submerged face 704.

Each of the tall reinforcement ribs 717 comprises a lumen 718 therethrough wherein each lumen connects a recessed notch 714 in the first opposing side 706 with a recessed notch 714 in the second opposing side 708. The recessed notch pair AE comprises lumen 718l

disposed through the tall reinforcement rib 717 connected to the exposed face 702. The recessed notch pair AE comprises lumen 718J disposed through the tall reinforcement rib 717 connected to the submerged face 704. The recessed notch pair BF comprises lumen 718K disposed through the tall reinforcement rib 717 connected to the exposed face 702. The recessed notch pair BF comprises lumen 718L disposed through the tall reinforcement rib 717 connected to the submerged face 704. The recessed notch pair CG comprises lumen 718M disposed through the tall reinforcement rib 717 connected to the exposed face 702. The recessed notch pair CG comprises lumen 718N disposed through the tall reinforcement rib 717 connected to the submerged face 704. The recessed notch pair DH comprises lumen 718O disposed through the tall reinforcement rib 717 connected to the exposed face 702. The recessed notch pair DH comprises lumen 718P disposed through the tall reinforcement rib 717 connected to the submerged face 704.

Each lumen disposed in a tall reinforcement rib 717 connected to the exposed face 702 is referred to as a top lumen (e.g. lumens closer to the exposed face 702 than the submerged face 704 are referred to as top lumens). That is, lumens 718I, 718K, 718M, 718O are top lumens. Each lumen disposed in a tall reinforcement rib 717 connected to the submerged face 704 is referred to as a bottom lumen (e.g. lumens closer to the submerged face 704 than the exposed face 702 are referred to as bottom lumens). That is, lumens 718J, 718L, 718N, 718P are bottom lumens.

The lumens 718I to 718P are disposed parallel to the width axis.

The plurality of short reinforcement ribs 716 are disposed in the internal volume 720 of the modular concrete floating block 700. Each of the short reinforcement ribs 716 connects the first opposing side 706 and the second opposing side 708. Each of the reinforcement ribs 716 connects the is connected to either: the exposed face 702; or, the submerged face 704.

The modular concrete floating block 700 is configured to float in water. The modular concrete floating block 700 is configured to float in water. For example, the modular concrete floating block 700 may be configured to float in fresh water such as that found in a river or a lake. For example, the modular concrete floating block 700 may be configured to float in salt water such as that found in the ocean.

The modular concrete floating block 700 is configured to connect to other modular concrete floating blocks 700 to thereby provide a modular concrete floating platform wherein the modular concrete floating platform comprises at least two blocks (see description of Figure 9).

The modular concrete floating block 700 is configured to float in water. When the modular concrete floating block 700 is floating on water, the submerged face 704 is configured to be submerged in water (e.g.; covered by water; facing down into the water) and the exposed face 702 is configured to be exposed (e.g. not covered by water; disposed in air; facing up away from the water). When the modular concrete floating block 700 is floating on water, a portion of each of the first opposing side 706, the second opposing side 708, the first end side 710, and the second end side 712 is configured to be submerged in water and another portion of each of the sides 706, 708, 710 and 712 is configured to be exposed.

Each of the lumens 718I to 718P is configured to receive a connecting bar.

Each of the recessed notches 714A to 714H of a modular concrete floating block 700 is configured to form a vertical channel with another recessed notch on another modular concrete floating block 700 when the two modular concrete floating blocks abut and are arranged so that two notches (i.e. one notch on a first modular concrete floating block and another notch on a second modular concrete floating block) align and abut. In the example shown the notches are trapezoidal e.g. the notches have a cross-section with the shape of an equilateral trapezium which is constant throughout the length of the recessed notch). Trapezoidal notches are configured to form hexagonal vertical channels e.g. the vertical channels have a cross-section with the shape of a regular hexagon which is constant throughout the length of the vertical channel.

Each vertical channel formed by the recessed notches 714A to 714H is configured to receive a column.

Figure 8 illustrates a side cross-sectional view of an alternative modular concrete floating block 800.

Instead of providing a plurality of short reinforcement ribs 716 and a plurality of tall reinforcement ribs 717 on the exposed face 702 and/or on the submerged face 704, a unitary reinforcement panel 750 may be provided (shown in Figure 8). In the example shown in Figure 8, a unitary reinforcement panel 750 is connected to the submerged face 704 and a plurality of short and tall reinforcement ribs are provided on the exposed face 702. The unitary reinforcement panel 750 is sized to permit lumens to be disposed therein. For example, the unitary reinforcement panel may have a height (e.g. dimension measured in the direction of a straight line connecting the exposed face and the submerged face) which is at least equal to that of a tall reinforcement rib in other examples.

Unitary reinforcement panels may be formed of C40/50 concrete.

An advantage of a unitary reinforcement panel in comparison to a plurality of short and tall reinforcement ribs is that it may be simpler (e.g. comparatively less steps, comparatively less time) to form the unitary reinforcement panel than to form each of the plurality of short and tall reinforcement ribs. As a result, the manufacturing cost of a modular concrete floating block with one (or two) unitary reinforcement panel(s) may be less than the manufacturing cost of a modular concrete floating block with a plurality of short and tall reinforcing ribs.

An advantage of providing a plurality of short and tall reinforcement ribs in comparison to providing a unitary reinforcement panel is that a lighter (e.g. comparatively less mass) modular concrete floating block may be provided e.g. for a given size, a modular concrete floating block comprising a plurality of short and tall reinforcement ribs may be lighter than a modular concrete floating block comprising a one (or two) unitary reinforcement panel(s). As a result, transportation of modular concrete floating block comprising a plurality of short and tall reinforcement ribs may be easier and/or cheaper than transportation of a modular concrete floating block comprising a one (or two) unitary reinforcement panel(s) (e.g.: less weight on a crane for loading and unloading the blocks from a transportation truck; less fuel required to move the blocks).

In examples, the first end side and the second end side of the modular concrete floating blocks may comprise recessed notches in the same manner as the recessed notches in

the first opposing side and the second opposing side. In a similar manner the recessed notches in the first end side and the second end side may be connected by lumens (e.g. secondary lumens). The secondary lumens are disposed parallel to the length axis. Importantly, the secondary lumens connecting the recessed notches disposed in the first end side and the second end side are provided at different heights (e.g. different distances from the submerged face) to the lumens (e.g. primary lumens) connecting the recessed notches disposed in the first opposing side and the second opposing sides i.e. so that the secondary lumens connecting the recessed notches disposed in the first end side and the second end side do not intersect the primary lumens connecting the recessed notches disposed in the first opposing side and the second opposing sides. In such examples, the columns may comprise additional through holes which align with the secondary lumens. Advantageously, providing recessed notches in the first end side and the second end side as well as providing recessed notches in the first opposing side and the second opposing side may allow the modular concrete floating blocks to be connecting in a greater number of ways (e.g.: opposing side to opposing side; end side to end side; opposing side to end side) in comparison to modular concrete floating blocks having recessed notches in the first and second opposing sides exclusively, thereby providing a greater versatility of the former in comparison to the latter.

Figure 9 illustrates a perspective view of a modular concrete floating platform system 900. Figure 10A illustrates a transparent top plan view of a first portion of the modular concrete floating platform system 900; Figure 10B illustrates a transparent top plan view of a second portion of the modular concrete floating platform system 900.

The modular concrete floating platform system 900 comprises: a plurality of modular concrete floating blocks 700A to 700D; a plurality of columns 910A to 910L; a plurality of connecting bars 930; a plurality of spacing members 940; and, a plurality of fastening means 950.

The modular concrete floating blocks 700A to 700D are the same as those shown in Figures 7A to 7E.

The modular concrete floating blocks 700A and 700B are shown in contact with one another i.e. abutting each other. The modular concrete floating blocks 700A and 700B are

arranged so that the recessed notches on a first opposing side of the first modular concrete floating block 700A are aligned and abutted with the recessed notches on the second opposing side of the second modular concrete floating block 700B to thereby form vertical channels 920A to 920D. The modular concrete floating blocks 700B and 700C are arranged so that the recessed notches on a second opposing side of the second modular concrete floating block 600B are aligned with the recessed notches on the first opposing side of the third modular concrete floating block 600C to thereby form vertical channels 920E to 920H.

The columns 910A to 910H are disposed into vertical channels 920A to 920H i.e. in the manner of, column 910A is disposed in vertical channel 920A, column 910B is disposed in vertical channel 920B, etc.

Each of the columns 910 to 910H is configured to fit within one of the vertical channels formed when two of the modular concrete floating blocks 700 abut. Each of the columns 910A to 910H comprises a hollow prism. The prism comprises a hexagonal cross-section. Each of the columns 910A to 910H is sized to fit in one of the vertical channels formed when two of the modular concrete floating blocks 700 abut e.g. the length of the column is the same as the length between the exposed face 702 and the submerged face 704 and lengths of the hexagonal sides of the columns is equal to the lengths of the trapezoidal non-parallel sides and the short parallel side of the trapezium which defines the shape of the recessed notches.

Each of the columns 910A to 910H comprises two through holes. A top through hole and a bottom through hole. The two through holes are configured to receive a connecting bar. The two through holes are configured to align with the two lumens disposed in each of the recessed notch pairs. The top through hole is configured to align with the top lumen when the column is disposed in the recessed notch. The bottom through hole is configured to align with the bottom lumen when the column is disposed in the recessed notch. In other words, the two through holes of each column are aligned with the width axis (e.g. a straight line disposed through one of the through holes in the columns is parallel to the width axis).

Each of the columns 910 to 910H is configured to protect the notches from damage e.g. a column disposed in vertical channel formed of two notches is configured to protect the two

notches from damage. In examples without columns, the notches which form the vertical channels may be damaged by impact of the connecting bars on the notches (e.g. if a connecting bar is impacted onto a notch when a misplaced attempt to insert the connecting bar into a lumen in the notch occurs). Advantageously, providing the columns may prevent damage of the notches (e.g. the column by absorb at least some of the impact force when a connecting bar is impacted onto the column notch when a misplaced attempt to insert the connecting bar into a lumen In the notch occurs).

The connecting bars have a longitudinal length. The connecting bars have a first end and a second end. The connecting bars are operable to pass through the lumens (e.g. a lumen in a first modular concrete floating block and a lumen in second modular concrete floating block, thereby joining the two modular concrete floating blocks). The connecting bars have a diameter less than or equal to the diameter of the lumens. For example, the connecting bars may form an interference fit in each lumen.

The connecting bars and fastening means are configured to connect two or more of the modular concrete floating blocks to thereby provide a modular concrete floating platform system.

The connecting bars are configured to engage the fastening means. The fastening means are configured to engage the connecting bars. The first and second ends of the connecting bars comprise a threaded portion and the fastening means comprises a corresponding threaded portion. For example, the first and second ends of the connecting bars comprise a male threaded portion and the fastening means comprise a corresponding female threaded portion.

A first connecting bar is disposed through: a top lumen in the first modular concrete floating block 700A; a top through hole in the column 910A; a top lumen in the second modular concrete floating block 700B; a top through hole in the column 910E; and, a top lumen in the third modular concrete floating block 700C. A second connecting bar is disposed through: a bottom lumen in the first modular concrete floating block 700A; a bottom through hole in the column 910A; a bottom lumen in the second modular concrete floating block 700B; a bottom through hole in the column 910E; and, a bottom lumen in the third modular concrete floating block 700C. In a similar manner, for the other recessed notch pairs of

each of the modular concrete floating blocks, additional connecting bars are disposed through lumens of modular concrete floating blocks and through holes of columns such that:

columns 910B and 910F receive a third and fourth connecting bar;

columns 910C and 910G receive a fifth and sixth connecting bar;

columns 910D and 910H receive a seventh and eighth connecting bar.

When the connecting bars are disposed through the lumens of the modular concrete floating blocks and through the through holes of the columns, the first end and second end of the connecting bars are fastening by a fastening means to prevent the modular concrete floating blocks moving out of abutment with one another and to prevent the connecting bars from exiting the lumens and columns.

In examples, each of the connecting bars may comprise a plurality of portions. The plurality of portions may be attachable to one another e.g. a longitudinal end of a first portion is connected to a longitudinal end of a second portion thereby providing a bar with a longitudinal length equal to the sum of the lengths of the first portion and the second portion.

In the modular concrete floating platform system shown in Figure 9, the first modular concrete floating block 700A is disposed at the end of the platform formed by the first, second and third modular concrete floating blocks 700A to 700C. The second opposing side of the first modular concrete floating block 700A does not abut another first modular concrete floating block and is referred to an outward-facing side. The notches of the modular concrete floating block 700A which are disposed on the outward-facing side are referred to as outward-facing notches.

Each of the plurality of notches 714A to 714H is configured to receive a fastening means.

For example, when a notch is outward-facing, the notch is configured to receive a fastening means. In other words, the fastening means is disposed within the notch.

A spacing member 940 is provided between the fastening means 950 and an outward-facing notch. For example, the notch is configured to receive the spacing member 940

which may protect the notch from damage from the fastening means 950. An example of an outward-facing notch receiving a spacing member 940 is shown in Figure 10B.

In examples, at least one of the first fastening means and the second fastening means are provided as an integral part of the respective recessed notches.

In examples, the first and second fastening means may each comprise a female threaded portion. In such examples, the connecting bar may comprise: a first male portion configured to engage the female thread portion of the first fastening means; a second male portion configured to engage the female thread portion of the second fastening means.

In examples, rather than the first fastening means and the second fastening means being disposed in the recessed notches, the first fastening means and the second fastening means are provided as an integral part of the lumen. For example, the first and second fastening means may each comprise a female threaded portion. In such examples, the connecting bar may comprise: a first male portion configured to engage the female thread portion of the first fastening means; a second male portion configured to engage the female thread portion of the second fastening means.

Forming a modular concrete floating platform comprises:

(i) providing a plurality of modular concrete floating blocks 700 on water (e.g. so that the blocks float on the water);

(ii) abutting a pair of modular concrete floating blocks, the pair comprising a first opposing side of a first modular concrete floating block 700A to a second opposing side of a second modular concrete floating block 700B, so that notches on the first opposing side of the first modular concrete floating block 700A and the second opposing side of the second modular concrete floating block 700B abut and align to thereby form vertical channels;

(iii) inserting a column into each of the vertical channels (e.g. to thereby protect the notches which form the vertical channel from damage);

(iv) inserting a connecting bar through a lumen in the first modular concrete floating block 700A and a lumen in the second modular concrete floating block 700B;

(v) repeating steps (ii) to (iv) to provide a unitary platform wherein all of the

plurality of modular concrete floating blocks 700 is abutted with at least one other modular concrete floating block, thereby providing two end modular concrete floating blocks wherein each modular concrete floating block has an outward-facing side comprising outward-facing notches;

(vi) attaching a fastening means to ends of connecting bars which protrude from the outward-facing notches to thereby prevent the modular concrete floating blocks from moving out of abutment with one another and to thereby prevent the connecting bar from exiting any of the lumens;

(vii) optionally, applying grouting between abutting modular concrete floating blocks (e.g. in the vertical channels) to thereby adhere the abutting modular concrete floating blocks.

Figures 11A and 11B illustrate a perspective view of another example of a concrete floating block 1000. Figure 11C illustrates a perspective view of an example concrete floating platform comprising two of the concrete flocking blocks 1000 shown in Figures 11A and 11B. Figure 11D illustrates a plan view of a pair of connecting bars and a coupler.

The concrete floating blocks 1000 shown in Figures 11A to 11C may be configured to couple together in a similar manner to the concrete floating blocks described above but instead of using hexagonal notches and grooves may instead use T-shaped recesses that when joined together form a void that may be filled with grout to couple the concrete floating blocks 1000 together, as will now be described in more detail. Like the examples described above, connecting bars 1200 may also be used to further couple the blocks 1000 together and improve the structural integrity of a concrete floating platform system comprising such blocks 1000.

The concrete floating block 1000 comprises: an exposed face 1010; a submerged face 1020; a first opposing side 1030; a second opposing side 1040; a first end side 1050; a second end side 1060; a plurality of recesses 1100A to 1100E; and, a plurality of connecting bars 1200A to 1200L each with an optional coupler.

The second opposing side 1040 may be identical to the first opposing side 1030 i.e. the second opposing side 1040 comprises: a plurality of recesses 1100A to 1100E; and, optionally a plurality of connecting bars corresponding to connecting bars 1200A to 1200L

(although it will be appreciated that only one set of connecting bars 1200A to 1200L may be required to couple two or more floating blocks 1000 together, for example if the connecting bars 1200 are sufficiently long to extend between the pair of floating blocks or through a plurality of floating blocks placed adjacent to each other). By making both sides of the floating block 1000 identical, the floating blocks 1000 may be used in a modular manner to easily and efficiently create a modular floating platform.

The concrete floating block 1000 is rectangular cuboid. The exposed face 1010 is disposed opposite the submerged face 1020. The first opposing side 1030 is disposed opposite the second opposing side 1040. The first end side 1050 is disposed opposite the second end side 1060. The exposed face 1010 and the submerged face 1020 are connected to the first opposing side 1030. The exposed face 1010 and the submerged face 1020 are connected to the second opposing side 1040. The exposed face 1010 and the submerged face 1020 are connected to the first end side 1050. The exposed face 1010 and the submerged face 1020 are connected to the second end side 1060. The first opposing side 1030 and the second opposing side 1040 are connected to the first end side 1050. The first opposing side 1030 and the second opposing side 1040 are connected to the second end side 1060. The exposed face 1010, the submerged face 1020, the first opposing side 1030, the second opposing side 1040, the first end side 1050 and, the second end side 1060 delimit an internal volume of the concrete floating block 1000.

The concrete floating block 1000 is a rectangular cuboid having a height, H, defined as the shortest distance between the exposed face 1020 and the submerged face 1010. A height axis is defined by a straight line connecting the exposed face 1020 and the submerged face 1010. The rectangular cuboid having a width, W, defined as the shortest distance between the first opposing side and the second opposing side. A width axis is defined by a straight line connecting the first opposing side and the second opposing side. The rectangular cuboid having a length, L, defined as the shortest distance between the first end side and the second end side. A length axis is defined by a straight line connecting the first end side and the second end side. The width axis, height axis and length axis are mutually orthogonal.

The internal volume of the concrete floating block 1000 contains a buoyant material. In other words, type and amount of the buoyant material is selected to provide a combined

system (e.g. the concrete floating block (excluding the buoyant material) and the buoyant material) which is buoyant in fresh water and/or salt water.

The buoyant material has a density less than the density of water (e.g. at a given temperature and pressure such as, 273 K and 101 kPa). In examples, the buoyant material may be: expanded polystyrene. The concrete blocks 1000 may have the same properties as other concrete blocks described herein. For example, concrete blocks 1000 may comprise reinforced concrete (e.g. comprising the same concrete set out above),

The plurality of recesses 1100A to 1100E are disposed in the first opposing side 1030. As set out above, a corresponding plurality of recesses 1100A to 1100E are disposed in the second opposing side 1040. Each of the plurality of recesses 1100A to 1100E extend from the exposed face 1010 to a point disposed part way between the exposed face 1010 and the submerged face 1020, such that when two opposing recesses are placed adjacent to each other/abut, there is an open end of the void formed therebetween in the exposed face 1010. Viewing the opposing faces of the blocks in plan, the recesses 1100A to 1100E have a T-shape. That is, the recesses 1100A to 1100E comprise two portions: a height portion 1101 and a length portion 1102. The length portion 1102 is a cuboid-shaped cavity with its longest axis extending along the length axis of the floating concrete block 1000. The height portion 1101 is a cuboid-shaped cavity with its longest axis extending along the height axis. The height portion 1101 extends between the exposed face 1010 and the length portion 1102 of the recess. The longest axis of the length portion 1102 is disposed perpendicular to the longest axis of the height portion 1101.

A concrete floating block 1000 may additionally or alternatively be connectable to another concrete floating block 1000 by the connecting bars 1200 disposed on the first and second opposing faces of the concrete floating blocks 1000. For example, the connecting bars 1200 may be used to connecting floating blocks 1000 together before the recesses/voids formed therebetween are filled with grout. Once the recesses/voids are filled with grout the connecting bars 1200 may remain in place to strengthen the connection between the floating blocks and to provide an additional level of structural integrity.

In examples, connecting bars 1200 on a first concrete floating block are configured to project from respective lumens of the first concrete floating block into respective lumens

disposed in a second concrete floating block to thereby couple the two blocks together. Accordingly, the lumens of the first concrete floating block may be configured to align with the lumens of the second concrete floating block. Each of the lumens may comprise a threaded portion configured to connect to a corresponding threaded portion disposed on each of the connecting bars 1200. For example, the threaded portion on the connecting bar 1200 may be a male threaded portion and the threaded portion on the respective lumen may be a female threaded portion. However, in other examples it will be appreciated that the connecting bars 1200 may be cast into the lumen of the concrete floating block (e.g., at the time the floating concrete blocks are cast), such that the connecting bar 1200 may not be removed.

In the examples shown, each of the connecting bars 1200 is disposed between a respective pair of voids e.g., so the connecting bars 1200 are interdigitated with said voids such that the spacing between a void and each of its nearest connecting bars 1200 is the same. Similarly, each of the lumens may be disposed between a respective pair of voids. In some examples, the lumens may be arranged to fall within each of the recesses 1100A to 1100E such that in use the connecting bars 1200 may extend through the void formed by two abutting recesses.

The relative spacing of the connecting bars 1200 and lumens to the voids ensures that when the connecting bars 1200 connect two concrete floating blocks together, recesses on the respective blocks align to thereby form voids.

In other examples, for example where the lumens are not threaded (e.g., when the connecting bars 1200 are cast into the concrete floating blocks), the connecting bars 1200 may additionally or alternatively be connected via an intermediate element e.g. a coupler element, as shown for example in Figure 11D. The example shown in Figure 11D comprises two opposing connecting bars 1200A, 1200B, each comprising a male threaded portion, coupled via an intermediate element which in this example is a coupler element 1210 which in this example comprises a female threaded portion to receive each of the male threaded portions of the respective connecting bars 1200A, 1200B. In examples wherein the connecting bars 1200 comprise female threaded portions then the intermediate element comprises a female-to-female connector (i.e. the intermediate element .comprises a male threaded portion).

The first opposing side 1030 of a first concrete floating block is disposed opposite a second opposing side 1040 of a second concrete floating block and the connecting bars on the first opposing side 1030 of the first concrete block are configured to align with and are connectable to the connecting bars on the second opposing side 1040 of the second concrete floating block, for example via couplers. In examples, the connecting bars 1200 may be joined using any of a screw fit (e.g. with corresponding male and female threads on respective connecting bars) and/or interference fit.

Two concrete floating blocks 700 are connectable such that when connected using the connecting bars 1200 one or more of the recesses on the first of the concrete floating block and a recess on a second concrete floating block abut and align to form a void. The void will have an open end for receiving grout.

When two concrete floating blocks 1000 are connected adjacent one another (i.e. so that the first opposing side 1030 of a first concrete floating block is disposed opposite a second opposing side 1040 of a second of a second concrete floating block), the T-shaped recesses on the first opposing side 1030 of the first concrete floating block are disposed opposite and in alignment with respective T-shaped recesses on the second opposing side 1040 of the second concrete floating block. In other words, when two concrete floating blocks are connected by the connecting bars 1200, T-shaped recesses on the first concrete floating block align with T-shaped recesses on the second concrete floating block.

The connecting bars 1200 are arranged at regular distances between the recesses 1100. Advantageously, this ensures that when the connecting bars of two concrete floating blocks 1000 are connected, then the recesses 1100 of said concrete floating blocks 1000 are aligned to thereby form voids.

When two concrete floating blocks 1000 are connected to one another via the connecting bars 1200, a grout (e.g. concrete, for example, the same concrete which forms the concrete floating block) may be disposed within the void. The grout is allowed to set to irreversibly secure the two concrete floating blocks together 1000. The grout, when set, forms a key between adjacent blocks which may prevent or reduce shear between the adjacent blocks.

When the grout is liquid it adopts the same shape as the void. When the grout sets, a solid grout member is provided with the shape of the void e.g. the solid grout member has a T-shape. Advantageously, the T-shape resists shear and/or torsional forces between the neighbouring floating bricks thereby providing a stable modular concrete floating platform. Moreover, given the relatively simple geometry of the T-shaped recesses 1100, the effort and cost to manufacture said concrete floating blocks (e.g. by providing a mould and pouring concrete therein) may be reduced.

A method of forming a modular concrete floating platform from a plurality of the concrete blocks (1000) comprises:

(i) connecting a first concrete floating block 1000 with a second concrete floating block, so that connecting bars 1200 on a first opposing side 1030 of the first concrete floating block connect to connecting bars on a second opposing side 1040 of the second concrete floating block, so that recesses 1100 on the first opposing side 1030 of the first concrete floating block abut and align with respective recesses 1100 in the second opposing side of the second concrete floating block to thereby form voids (e.g. the void comprising a recess from the first concrete floating block and a recesses from the second concrete floating block).

For example, two concrete floating blocks are floated on a body of water and manoeuvred so that an opposing side of one of the blocks abuts an opposing side of the other block. Then the connecting bars of one block are connected to those of the other block (e.g. by any of a screw fit (e.g. with corresponding male and female threads on respective connecting bars and couplers) and/or an interference fit).

The method further comprises:

(ii) applying grouting in the voids to thereby adhere the connected concrete floating blocks to provide a modular concrete floating platform.

When the grout adopts the same shape as the voids it may bond the two concrete floating blocks together.

In such examples, the first end face of a first concrete floating block may be connected to

the second end face of a second concrete floating block. In such examples, recesses in the first end face of the first concrete floating block oppose recesses in the second end face of the second concrete floating block to thereby form voids as described above (e.g. suitable for filling with a grout).

In examples, one or more recesses in a side of a first concrete floating block abut one or more recesses on a side of a second concrete floating block to thereby form one or more voids. For example, the voids may have a T-shaped cross-section and may be configured to receive a grout as described herein.

Other examples and variations of the disclosure will be apparent to the skilled addressee in the context of the present disclosure.

CLAIMS:

1. A modular concrete floating platform system comprising a plurality of concrete floating blocks (1000);

wherein each concrete floating block (1000) is filled with a buoyant material and comprises a submerged face (1010) configured to be submerged in water, and an exposed face (1020) configured to be exposed when the block is floating on water, each block further comprising a pair of opposing sides (1030, 1040) connecting the submerged face to the exposed face;

wherein each of the opposing sides comprises a plurality of recesses (1100A-E) and a plurality of lumens for receiving respective connecting bars (1200) to couple a first concrete floating block adjacent to a second concrete floating block, wherein the recesses on an opposing side of the first concrete floating block abut and align with the recesses on an opposing side of the second concrete floating block to thereby form a plurality of voids between the adjacent concrete floating blocks, and wherein the plurality of voids between adjacent concrete floating blocks are filled with grout.

2 The modular concrete floating platform system of claim 1 wherein each recess of each concrete floating block is T-shaped.

3. The modular concrete floating platform system of claim 2 wherein the plurality of voids each have a T-shape cross-section.

4. The modular concrete floating platform system of any of the previous claims wherein the connecting bars are connected by any of a screw fit and/or an interference fit.

5. The modular concrete floating platform system of any of the previous claims wherein the concrete is reinforced concrete.

6. The modular concrete floating platform system of claim 5 wherein the concrete is reinforced with basalt rebar.

7. The modular concrete floating platform system of any of the previous claims wherein the buoyant material comprises expanded polystyrene.

8. A concrete floating platform block (1000) for use with a modular concrete floating platform system;

wherein the concrete floating block (1000) is filled with a buoyant material and comprises a submerged face (1010) configured to be submerged in water, and an exposed face (1020) configured to be exposed when the block is floating on water, each block further comprising a pair of opposing sides (1030, 1040) connecting the submerged face to the exposed face;

wherein each of the opposing sides comprises a plurality of recesses (1100A-E) and a plurality of connecting bars (1200), wherein each of the connecting bars (1200) of the concrete floating block is connectable to a corresponding connecting bar of another concrete floating block to couple the concrete floating block adjacent to the other concrete floating block, wherein when the concrete floating block is connected and adjacent to another concrete floating block the recesses on an opposing side of the concrete floating block abut recesses on an opposing side of the other concrete floating block to thereby form a plurality of voids between the concrete floating block and the other concrete floating blocks, wherein when at least two said concrete floating blocks are coupled together with the one or more connecting bars, the plurality of voids between adjacent concrete floating blocks are filled with grout.

9. A method of forming a modular concrete floating platform from a plurality of concrete blocks (1000), the method comprising:

(i) connecting a first concrete floating block (1000) with a second concrete floating block, so that connecting bars on a first opposing side of the first concrete floating block connect to connecting bars on a second opposing side of the second concrete floating block, so that recesses on the first opposing side of the first concrete floating block abut and align with respective recesses in the second opposing side of the second concrete floating block to thereby form vertical voids;

(ii) applying grouting in the vertical voids to thereby adhere the connected concrete floating blocks to provide a modular concrete floating platform.

Application No:	GB2214279.8	**Examiner:**	Mr Richard Collins
Claims searched:	1 to 9	**Date of search:**	8 March 2023

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	WO2017/093772 A1 (POMPOR) see the modular concrete floating blocks 2, connecting bars 15 and recessed notches in figure 3 especially.
A	-	US5192161 A (HELGESSON) see the figures and abstract.
A	-	WO2007/105955 A1 (OEVRETVEIT) see the whole document.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

B63B; E02B

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
B63B	0035/38	01/01/2006
B63B	0005/20	01/01/2006
B63B	0073/10	01/01/2020
B63B	0075/00	01/01/2020
E02B	0003/06	01/01/2006