(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 September 2020 (17.09.2020)

WIPO | PCT

(10) International Publication Number
WO 2020/181326 A1

(51) International Patent Classification:
E04G 11/46 (2006.01) *E04B 5/32* (2006.01)

(21) International Application Number:
PCT/AU2020/050225

(22) International Filing Date:
11 March 2020 (11.03.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2019900795 11 March 2019 (11.03.2019) AU

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: VOID FORMER AND MODULAR FORMWORK SYSTEM

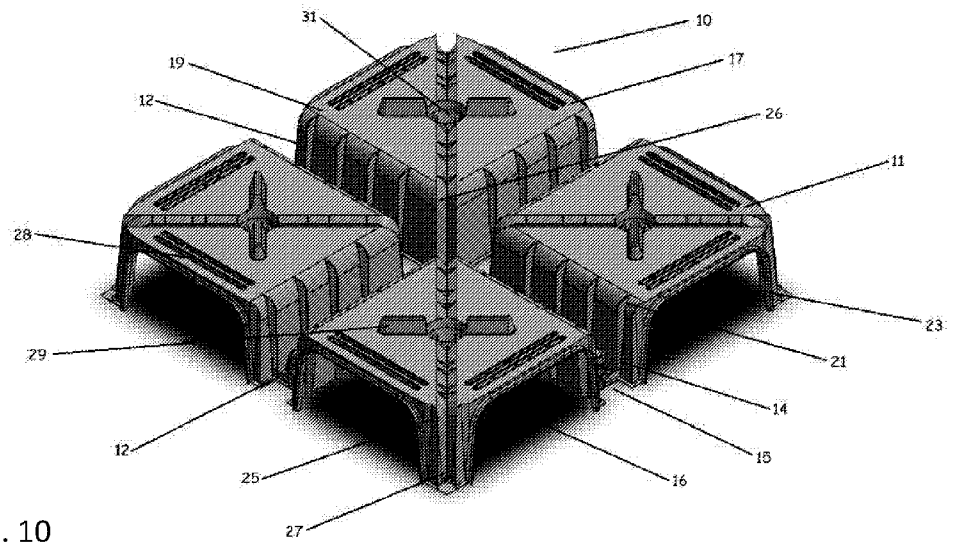


Fig. 10

(57) Abstract: A void forming arrangement for forming voids in a concrete slab, the arrangement comprising a void forming element comprising an upper surface supported by side support structures, the side support structures being located at the periphery of the upper surface and comprising at least one support wall and at least one support leg, the side support structures and the upper surface defining a void; the side support structures defining at least one opening into the void; and, an extender configured to be inserted into the opening, the extender being configured to extend the void forming element and to close the opening.

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Published:
— *with international search report (Art. 21(3))*

VOID FORMER AND MODULAR FORMWORK SYSTEM

TECHNICAL FIELD

This disclosure relates to void or cavity formers and to modular formwork systems for forming voids in concrete slabs.

BACKGROUND ART

Conventional slab preparation in some cases utilises uniform monolithic foundation slabs. These do not provide an optimum distribution of concrete but, rather, rely upon a uniform maximum thickness, even though such uniform maximum thickness is not structurally necessary for withstanding the compressive stresses under actual load conditions. An alternative approach is to excavate a number of trenches and position reinforcing rods and reinforcing mesh in and over the trenches. Concrete is then poured to embed the reinforcing rods and to cover the soil blocks between the trenches so that the concrete forms a continuous slab on its upper surface. The concrete in the filled trenches forms beams to strengthen the slab. However, this arrangement is expensive, slow and unsuitable for reactive soils.

These conventional slab preparation methods have been improved by the use of void formers. Multiple void formers are employed to create voids in the underside of the slab. Reinforcing rods are placed in the gaps between the void formers and reinforcing mesh is held on chairs or grooves on the top of the void formers.

EPS foam blocks are the most commonly used void formers. EPS foam is environmentally disadvantageous, may have high levels of on-site waste, and high transportation costs. In addition, foam blocks result in high labour costs to position the formers on site and the need for accessories to space the formers and to position and hold reinforcing rods and mesh in-place before and during the concrete pour.

It is to be understood that, if any prior art is referred to herein, such reference does not constitute an admission that the prior art forms a part of the common general knowledge in the art in Australia or any other country.

SUMMARY

The disclosure generally relates to a void former or a void forming arrangement that comprises a small number of parts including variously sized void forming elements defining voids with an opening extending into some of the voids. In some forms the void forming elements comprise pods forming an array of voids in use. In some forms the void forming elements form four voids with two voids having openings extending therein. In some forms an extender is configured to extend or close the various void forming elements regardless of their size. This allows for a simple and effective process to produce slabs of varying sizes.

The disclosure also relates to void forming kits or systems that comprise few parts that are lightweight and can be easily transported and stored and can be used without the need to provide multiple variant parts.

Disclosed in some forms is a void forming arrangement for forming voids in a concrete slab, the arrangement comprising a void forming element comprising an upper surface supported by side support structures, the side support structures being located at the periphery of the upper surface and comprising at least one support wall and at least one support leg, the side support structures and the upper surface defining a void; the side support structures defining at least one opening into the void; and, an extender configured to be inserted into the opening, the extender being configured to extend the void forming element and to close the opening. In some forms the side support structures define at least two openings on one void forming element.

In some forms the void forming element is in the form of a pod.

The system has the benefit of simplifying building formwork for a slab by utilising fewer elements. In some forms this simplification includes allowing for

different sized void forming elements to be used with a single extender. Variant sizes of the void forming element or pod do not require varied extenders. The various void forming element sizes and the extenders can form all of the required classes of concrete slabs and set- downs. This has the benefit of simplifying the process and allowing various sizes of slabs and set downs to be formed with a simple multi piece system. In some forms, the system may also have the benefit of including additional accessories within the simplified system. For example, accessories may be integrally formed with the void forming element. These accessories may include spacers, bar chairs, strengthening ribs, support ribs. Similarly any engaging clips may be integrally formed with the extender or simply not required by the manner of engagement. Building these accessories integrally with the void former means that a builder does not require multiple different elements but can utilise the simplified void forming system. The benefit of simplifying the process may increase efficiency and reduce costs and waste.

In some forms the extender is also configured to create voids for set-down, set-up or block-out zones within the slab. In some forms the extender is configured to stand alone.

In some forms disclosed is an array of void forming elements and one or more extenders.

In some forms the arrangement further comprises a plurality of channels extending through the void forming arrangement, the channels being defined by channel walls and separating the void forming elements from adjacent void forming elements;

In some forms the void forming elements are oriented such that the openings are located on an outer edge of the arrangement.

In some forms the extender includes an outer wall extending on a top and two sides to define an interior passage extending through the extender. In some forms the extender further includes a barrier acting to at least partially close the interior passage. In some forms the barrier is located inside the passage.

In some forms the opening in the void forming element is sized such that the extender may be positioned and held therein. In some forms the extender fits into the opening and strengthens the void forming element. In some forms the opening includes at least one ridge extending around the opening. In some forms the ridge is a curved ridge shaped to fit with a similar curve. In some forms the extender is adapted to engage with the ridge. In some forms the extender supports the edge of the opening and strengthens the ridge.

In some forms the extender incorporates a tear away structure to allow for the minimum length of extender to be used to reduce waste and overlap of materials. In some forms the tear away structure is in the form of a rip away section or a frangible section.

In an alternative embodiment, disclosed is a void forming arrangement for forming voids in a concrete slab, the arrangement comprising an array of void forming elements, a plurality of channels extending through the void forming arrangement, the channels being defined by channel walls and separating the void forming elements from adjacent void forming elements; and a bar support located within at least a portion of the plurality of channels for supporting a bar extending through the channels.

In some forms the bar support is integrally formed with the void forming arrangement.

In some forms the arrangement further comprises a strengthening element that extends diagonally across the upper surface of the void forming element.

In some forms the strengthening element comprises a groove.

In some forms the strengthening element extends up the support structure and across the void forming element to a second support structure.

In some forms the channel walls meet the upper surface at a curved profile.

In some forms, the arrangement further comprises one or more ribs extending across the upper surface. In some forms one or more of the ribs extend substantially parallel with an edge of the void forming element, and wherein one or more of the ribs at an angle between 30 and 60 degrees with respect to the other ribs.

In some forms the upper surface of each void forming element is substantially coplanar with the upper surface of other void forming elements in the array.

In some forms each arrangement is adapted to be engaged with an adjacent arrangement.

In some forms the void forming arrangement is formed of a single integrated piece.

Further disclosed is an extender for a void forming arrangement, the extender comprising an elongate body, the body defining an interior passage extending through the extender and a barrier located within the interior passage.

In some forms the body comprises a wall extending on at least three sides to define the interior passage. In some forms the wall has a ribbed outer surface. In some forms the wall includes a break extending around a portion of an outer surface of the body to allow the extender to be split.

The arrangement may have the benefit of being modular and allowing multiple arrays or elements to be joined together to provide for a slab with dimensions that are non-standard. The arrangement may mean that multiple different elements, parts and accessories are not required to build a formwork even when the shape is not standard. In some forms the element or arrangement may include one or more openings to allow an array to be joined to another array of void forming elements. The developed formwork produces a concrete foundation with a geometry that may have better resistance to displacement due to reactive soils. The formwork also may achieve better resistance to punching shear. This is achieved because of

the improved shape of the ribs formed in the module, and the arch shape and additional support structures that are incorporated in the module design.

Use of the void forming arrangement reduces the amount of concrete required to achieve a given performance. In addition, the mass of plastic used to manufacture the formwork is minimised through the efficient structural design of the module taking into account effective load transfer methods using arches, ridges and stiffeners to resist loads.

The arrangement may have the benefit of having a single piece acting as extender for various sizes of void element and for various extension requirements. The extender may also act to close the opening in the void forming element.

The arrangement may have benefits in labour saving in that the formwork for the slab along with strengthening concrete ribs and beams may be integrated within the module and the bar chairs or supports. The integrated chairs to support the bars also save labour. This means labour costs for setting out formwork to create the ribs is reduced. Also, higher quality control may be maintained, and inspection time is reduced. No accessories (or reduced accessories) are required to space the modules or to form the concrete ribs and to provide cover for reinforcement bars.

In addition the arrangement may have benefits for transport and storage of the void forming system. In some forms the system is designed to be stacked, in some forms stacking strengthens the void forming elements. In some form the arrangement has benefits for load restraint.

In some forms, disclosed is a method of producing a slab utilising a plurality of void forming elements and at least one extender which acts to extend the void forming elements and close the void forming elements.

In some forms, disclosed is a method of forming a slab having voids, the method comprising selecting a plurality of void forming elements to form an array sized to form a slab, the plurality of void forming elements being selected from a group of void forming elements comprising at least void forming elements of a first size and void forming elements of a second size, at least a portion of the void forming elements including an opening extending through a wall of the void forming element; positioning extenders in the openings to connect the void forming elements to form the array, the extenders being shaped to close the openings.

The void forming arrangement may provide at least some of the formwork for a slab. For example, the void forming arrangement may enable ribs and beams to be formed therein, which may be integrated into the slab, allowing for decreased labour time in providing such slab-strengthening features.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Fig. 1 shows a perspective view of a void forming arrangement of one embodiment of the disclosure;

Fig. 2 is a plan view of the void forming arrangement of Fig. 1;

Fig. 3 is a side view of the void forming arrangement of Fig. 1;

Fig. 4 is a plan view of an embodiment of a void forming arrangement;

Fig 5 is a perspective view of an extender of one embodiment of the disclosure;

Fig 6 is a plan view of the extender of Fig. 5;

Fig. 7 is a side view of the extender of Fig. 5;

Fig 8 is an end view of the extender of Fig. 5;

Fig 9 is a perspective view of an extender and a void forming element of one embodiment of the disclosure;

Fig. 10 is a perspective view of a void forming arrangement of a second embodiment of the disclosure;

Fig. 11 is a plan view of the void forming arrangement of Fig. 10;

Fig. 12 is a side view of the void forming arrangement of Fig. 10;

Fig. 13 is a plan view of a further embodiment of a void forming arrangement.

DETAILED DESCRIPTION

In the following detailed description, reference is made to accompanying drawings which form a part of the detailed description. The illustrative embodiments described in the detailed description, depicted in the drawings and defined in the claims, are not intended to be limiting. Other embodiments may be utilised and other changes may be made without departing from the spirit or scope of the subject matter presented. It will be readily understood that the aspects of the present disclosure, as generally described herein and illustrated in the drawings may be arranged, substituted, combined, separated and designed in a wide variety of different configurations, all of which are contemplated in this disclosure.

Disclosed is a void forming arrangement for forming voids in a concrete slab, the arrangement comprising: an array of void forming elements, a plurality of channels extending through the void forming arrangement, the channels being defined by channel walls and separating the void forming elements from adjacent void forming elements; each void forming element comprising an upper surface, the upper surface being supported by support structures in the form of the channel walls or support legs; and a strengthening element extending across the upper surface of each void forming element from a first supporting structure to a second supporting structure.

In some forms a first set of the channels extend in a first direction and a second set of the channels extend in a second direction, the first and second directions being substantially transverse to one another.

In some forms the channels extend the length or width of the arrangement.

In some forms the strengthening element extends diagonally across the upper surface of each void forming element.

In some forms the strengthening element comprises a groove. In some forms the strengthening element extends up the support structure, across the upper surface and down an opposing support structure.

In some forms the strengthening element forms an arch extending from one support structure, across the upper surface to another support structure.

In some forms the arrangement further comprises a plurality of grooves extending up the channel walls.

In some forms the channel walls meet the upper surface at a curved profile.

In some forms the arrangement further comprises one or more ribs extending across the upper surface. In some forms the one or more ribs extend substantially parallel with an edge of the void forming element. In some forms the one or more ribs extend substantially transverse to the strengthening element.

In some forms the upper surface of each void forming element is substantially coplanar with the upper surface of other void forming elements in the array.

In some forms each arrangement is adapted to be engaged with an adjacent arrangement.

In some forms the arrangement further comprises a pillar support extending downwardly from the upper surface within the periphery of the void forming element. In some forms the pillar support is hollow.

In some forms the strengthening element comprises two strengthening grooves substantially at right angles to one another.

In an alternative embodiment, disclosed is a void forming element for forming a void in a concrete slab, the element comprising an upper surface, the upper surface being supported by support structures in the form of one or more walls or support legs; a strengthening element extending across the upper surface of the void forming element from a first support structure to a second support structure.

In some forms the strengthening element extends diagonally across the upper surface of the void forming element. In some forms the strengthening element comprises a groove. In some forms the strengthening element extends up at least one support structure. In some forms the strengthening element forms an arch extending from one support structure, across the upper surface to another support structure.

The benefits of the arrangement are that the geometry of the strengthening element extending across the void forming element from a first support structure to a second support structure allows for a substantially planar upper surface across multiple void forming elements while providing the resistance and strength of a strengthening element inbuilt without requiring additional labour.

Referring now to Figs. 1 - 3, disclosed is a void forming arrangement 10 for forming voids in poured concrete slabs. In a simple or basic form, the void forming arrangement 10 may comprise just one (i.e. a single) void forming element 11. However, as depicted, the void forming arrangement 10 comprises an array of (e.g. four) void forming elements 11. The void forming elements 11 in the illustrated form are arranged to be positioned adjacent one another at two sides.

A plurality of channels 12 divide the void forming elements from one another by extending through the void forming arrangement. The channels 12 are defined by channel walls 14 which extend upwardly from a channel base 15 to meet an upper surface 17 of the void forming elements. The channel walls 14 form supports for

the upper surface 17. The channel walls 14 meet the upper surface 17 at a curved profile 19. In the illustrated form the channel walls extend from the channel base at a lower position 20 that is substantially in vertical alignment with the curved profile 19. The void forming elements are made up of between one and four channel walls 14. Sides of the void forming element that do not have a channel wall may have an opening 16 which is defined by a peripheral leg 23. In the illustrated form the peripheral legs extend from the channel base to the upper surface 17.

In some forms two openings are located in the side walls of each void forming element. This allows for joining the void forming element to other elements and also may have the benefit of saving on plastic.

Further in the illustrated form, a locking ridge 38 extends about at least a portion of the edge of the opening 16. The locking ridge may be in the form of a curved or folded over section of the plastic at the peripheral edge of the opening. The locking ridge 38 has the benefits of strengthening the opening.

In the illustrated form, a set of channels 12 extend in a first direction while a second set 12 extend in a second direction. The sets of channels intersect substantially at right angles on the void forming arrangement 10 to form void forming elements that have a substantially square upper surface.

In the illustrated form the channel base 15 includes integrally formed supports 24 which extend upwardly within the channel 12. These supports 24 are shaped as a protrusion having a profiled upper surface. In the illustrated form the profiled upper surface comprises a curved profile having a central dip however alternative upper surface or alternatively shaped supports or seats are available. The supports may be utilized to support reinforcing rods which are located in the channel 12.

The channel walls 14 include a plurality of upwardly extending grooves 21 extending up the channel walls. The grooves serve to further strengthen the channel walls.

The upper surface 17 may in some forms be supported by supporting elements in the form of the channel walls 14 and peripheral support legs 23. In some forms the channel walls and peripheral support legs have an intermediate space or opening. In some forms the void forming elements have a cube or rectangular prism shape that allows for the upper surfaces 17 to be aligned with one another to form a planar face.

In some forms a strengthening element 25 extends up one supporting element such as up one channel wall through, for example, a wall groove at 26 and down a diagonally opposing peripheral leg support at 27. The strengthening element extends diagonally across the upper surface 17 of the void forming element 11. The strengthening element in the illustrated form is in the form of a groove extending into the upper surface and forms an arch extending diagonally across the void forming element. The strengthening element may be in other forms.

In alternative forms the strengthening element may form an arch between adjacent supporting elements or may form a partial arch, for example, by extending up one supporting element and across the upper surface of the void forming element.

In some forms, the void forming element 11 also includes peripheral ribs 28 extending upwardly across the upper surface 17 of the void forming element. In some forms the ribs are angled with respect to the strengthening element 25. In some forms the ribs extend along an edge of the upper surface 17.

In some forms the upwardly protruding peripheral ribs 28 are formed integrally on the upper surface of the top wall above the apertures and are formed between the legs and the intersection of the intersecting channel walls, these ribs are also used for supporting reinforcing mesh above the hollow module.

In some forms central ribs 29 are positioned proximal a centre of the upper surface 17. In some forms the central ribs extend approximately transverse the strengthening element. In some forms either or both of the peripheral ribs and central ribs act to support a reinforcing mesh positioned above the void forming arrangement 10. In some forms the central ribs 29 and peripheral ribs 28 may

form a triangular or other shape to support mesh above the upper surface of the void forming element. In some form the ribs may be positioned in other ways to form an integral mesh support.

In some forms the void forming arrangement includes an opening at the intersection of the channels 12 which abut grooves 34 formed in the base 15 of the channel defining a form that, when concrete is poured, forms a pillar to provide additional support for the slab.

In some forms, the void forming element 11 further includes a pillar support 31. The pillar support 31 in the illustrated form extends centrally through the upper surface 17 and has a similar length to that of the channel walls 14. In some forms the pillar support 31 is hollow and tapered. The pillar support 31 may act to brace the upper surface 17 to an underlying surface on which the channel walls 14 and peripheral legs 23 rest.

In the illustrated form the channel walls 14 and peripheral support legs 23 are integral with the upper surface 17. In some forms these supporting structures may be engaged with the upper surface. The arrangement 10 has the benefit of providing a substantially planar series of upper surfaces that extend substantially in line with one another while providing sufficient load transfer performance.

The arrangement 10 is a modular assembly allowing a plurality of elements and a plurality of arrays to be attached with one another to provide the necessary dimensions for a slab. The arrangement in some forms comprises four pods. In some forms each pod allows for two openings and two closed walls.

Referring now to Fig. 4, in some forms each void forming element 11 forms part of a void forming module 31. For example, a void forming module may comprise four, sixteen, or any number of void forming elements connected together. A plurality of modules are able to be joined together provide the formwork with the necessary dimensions required for the foundation slab. In some forms the modules may be composed of a preselected number of void forming elements. In some forms the void forming module comprises a plurality of sets of four void forming

elements that are connected together. The connection of the void forming element sets forms a tessellated centre square which is connected using extenders. In some form the void forming elements may be connected directly to the next module.

The modules include openings on an outer side. The opening is positioned between the channel walls and the peripheral support legs. This opening allows for an extender or an extension accessory to be used to fill the space and join two arrays or elements together allowing the modules to be joined to fit the dimensions needed and also allowing the joined modules or elements to resist movement. It may provide a robust connection for a plurality of elements or modules. The extender may extend the void formed in the slab while also closing off the void to the slab material. In addition the extender may form a void former for a setdown or setup portion of the slab. The combination of varying shapes and/or sizes of void forming elements having in-built openings or apertures with a single extender sized to fit the openings allows for simplicity in forming a slab. The openings allow an extender to be inserted to extend the void and/or join used to create a foundation of any size or shape. For example in the case of 2 sized void forming elements in a 300mm and 225 mm height, the openings remain consistent so that the same extender can be utilized. In a further example a 300mm void element may be engaged with a 225mm void element.

Peripheral ribs 28 are in the illustrated form aligned as needed, for example they may be aligned about the edge of the module and also aligned to cross over in the centre.

Referring now to Fig. 5 through 8, disclosed is an extender 40 which is adapted to engage with a void forming element (not illustrated in this figure). The extender is shaped and configured so that it may extend the void or close the opening 16 or perform both roles. The extender may be utilized in void forming elements of various sizes to allow for a simplified process of creating slabs of any size.

In some forms the extender 40 is used to fill small spaces at the periphery of the slab to extend the void forming assembly to the necessary dimensions. In other forms the extender 40 acts to join more than one void forming module. The extender 40 may act to extend the void former and may also act to close the void former.

The extender 40 in the illustrated form comprises an extender body 41 having a ribbed outer surface 43 which extends around three sides of an interior passage 44 and defines the interior passage 44. The ribbed outer surface includes a spacer gap 46 that allows for the extender to be ripped apart to form two separate extenders or to shorten the extender. This means the minimum amount of the item is consumed in forming the slab. In some forms the pull apart section may be frangible or otherwise formed to allow for easy splitting of the extender into parts.

A panel 47 is located inside the interior cavity 44 of the extender and acts to close or partially close the passage 44. When the extender is pulled apart into two separate extender pieces one of those pieces includes the panel 47 while the other is open. In other forms the panel closes both extender pieces.

The ribs allow for positioning of the extender within the opening at the correct position. The extender passage is consistent to extend the void as needed and close the opening as needed.

Referring now to Fig. 9, shown is the system of the void forming element 11 in an array along with a plurality of extenders 40. As shown in the figure, the opening 16 has a peripheral locking ridge 38 which extends around at least a portion of the opening 16. In this form the locking ridge is a curved ridge having a scrolled or turned over edge that is turned over to extend the opposing direction from the edge of the opening 16. In some forms the locking ridge 38 comprises a curved lip.

Figs. 10 – 12 show a void forming arrangement similar to that shown in earlier embodiments. In these figures like features are designated by like reference

numerals. The void forming arrangement 10 comprises an array of (e.g. four) void forming elements 11.

A plurality of channels 12 divide the void forming elements from one another by extending through the void forming arrangement between the void forming elements. The channels 12 are defined by channel walls 14 which extend upwardly from a channel base 15 to meet an upper surface 17 of the void forming elements. The channel walls 14 form supports for the upper surface 17. The channel walls 14 meet the upper surface 17 at a curved profile 19. In the illustrated form the channel walls extend from the channel base at a lower position 20 that is substantially in vertical alignment with the curved profile 19. The upper surface 17 of the void forming elements are supported by between one and four channel walls 14. Sides of the void forming element that do not have a channel wall may have an opening 16 which is defined by one or more peripheral legs 23. In the illustrated form the peripheral legs extend from the channel base to the upper surface 17 at a position that would form one edge of the channel wall.

In some forms two openings are located in the side walls of each void forming element. This allows for joining the void forming element to other elements and also may have the benefit of saving on plastic.

Further in the illustrated form, a locking ridge 38 extends about at least a portion of the edge of the opening 16. The locking ridge may be in the form of a curved or folded over section of the plastic at the peripheral edge of the opening. The locking ridge 38 has the benefits of strengthening the opening.

In the illustrated form, a set of channels 12 extend in a first direction while a second set 12 extend in a second direction. The sets of channels intersect substantially at right angles on the void forming arrangement 10 to form void forming elements that have a substantially square upper surface. In the illustrated form the upper surface has a generally square shape with indented corners and/or cutouts extending into the corners.

In the illustrated form the channel base comprises spaced apart webs 15 that extend across the channel 12 to engage the void forming elements on either side of the channel. This includes integrally formed supports 24 which extend upwardly within the channel 12. These supports 24 are shaped as a protrusion having a profiled upper surface. In the illustrated form the profiled upper surface comprises a curved profile having a central dip however alternative upper surface or alternatively shaped supports or seats are available. The supports may be utilized to support reinforcing rods which are located in the channel 12. The profile of the upper edge of the support provides for locating a bar in the channel such that the bar is positioned intermediate the channel walls and a distance is maintained within the channel walls. In some forms the supports comprise two upwardly extending curved arches with relatively flat tops separated by a depression which is located intermediate the channel walls.

In the illustrated form the supports 24 are intermediate two webs 15 that form the base of the channel. In the illustrated form the supports 24 may locate the reinforcing rods within the channel.

The channel walls 14 include a plurality of upwardly extending grooves 21 extending up the channel walls. The grooves serve to further strengthen the channel walls. In this illustrated form, the channel walls include grooves which extend upwardly from the spaced apart webs 15 that form the base of the channel.

The upper surface 17 may in some forms be supported by supporting elements in the form of the channel walls 14 and peripheral support legs 23. In some forms the channel walls and peripheral support legs have an intermediate space or opening. In some forms the void forming elements have a cube or rectangular prism shape that allows for the upper surfaces 17 to be aligned with one another to form a planar face.

In some forms a strengthening element 25 extends up one supporting element such as up one channel wall through, for example, a wall groove at 26 and down a diagonally opposing peripheral leg support at 27. The strengthening element

extends diagonally across the upper surface 17 of the void forming element 11. The strengthening element in the illustrated form is in the form of a groove extending into the upper surface and forms an arch extending diagonally across the void forming element. The strengthening element may be in other forms.

In alternative forms the strengthening element may form an arch between adjacent supporting elements or may form a partial arch, for example, by extending up one supporting element and across the upper surface of the void forming element.

In some forms, the void forming element 11 also includes peripheral ribs 28 extending upwardly across the upper surface 17 of the void forming element. In some forms the ribs are angled with respect to the strengthening element 25. In some forms the ribs extend along an edge of the upper surface 17. In the illustrated form the peripheral ribs are double ribs.

In some forms the upwardly protruding peripheral ribs 28 are formed integrally on the upper surface of the top wall above the apertures and are formed between the legs and the intersection of the intersecting channel walls, these ribs are also used for supporting reinforcing mesh above the hollow module.

In some forms central ribs 29 are positioned proximal across the centre of the upper surface 17. In some forms the central ribs extend approximately transverse the strengthening element. In some forms the central ribs and the strengthening element form a central cross at the centre of the upper surface 17. In some forms either or both of the peripheral ribs and central ribs act to support a reinforcing mesh positioned above the void forming arrangement 10. In some forms the central ribs 29 and peripheral ribs 28 may form a triangular or other shape to support mesh above the upper surface of the void forming element. In some form the ribs may be positioned in other ways to form an integral mesh support.

In some forms the void forming arrangement includes an opening at the intersection of the channels 12 which abut grooves 34 formed in the base 15 or the supports 24 of the channel defining a form that, when concrete is poured, forms a pillar to provide additional support for the slab.

In some forms, the void forming element 11 further includes a pillar support 31. The pillar support 31 in the illustrated form extends centrally through the upper surface 17 and has a similar length to that of the channel walls 14. In some forms the pillar support 31 is hollow and tapered. The pillar support 31 may act to brace the upper surface 17 to an underlying surface on which the channel walls 14 and peripheral legs 23 rest.

In the illustrated form the channel walls 14 and peripheral support legs 23 are integral with the upper surface 17. In some forms these supporting structures may be engaged with the upper surface. The arrangement 10 has the benefit of providing a substantially planar series of upper surfaces that extend substantially in line with one another while providing sufficient load transfer performance.

The arrangement 10 is a modular assembly allowing a plurality of elements and a plurality of arrays to be attached with one another to provide the necessary dimensions for a slab.

Referring now to Fig. 13, in some forms each void forming element 11 forms part of a void forming module 41. For example, a void forming module may comprise four, sixteen, or any number of void forming elements 11 connected together. A plurality of modules are able to be joined together provide the formwork with the necessary dimensions required for the foundation slab. In some forms the modules may be composed of a preselected number of void forming elements. In some forms the void forming module comprises a plurality of sets of four void forming elements that are connected together. The connection of the void forming element sets forms a tessellated centre square which is connected using extenders. In some form the void forming elements may be connected directly to the next module.

The modules include openings on an outer side. The opening is positioned between the channel walls and the peripheral support legs. This opening allows for an extender or an extension accessory to be used to fill the space and join two arrays or elements together allowing the modules to be joined to fit the dimensions needed and also allowing the joined modules or elements to resist

movement. It may provide a robust connection for a plurality of elements or modules. The extender may extend the void formed in the slab while also closing off the void to the slab material. In addition the extender may form a void former for a setdown or setup portion of the slab. The combination of varying shapes and/or sizes of void forming elements having in-built openings or apertures with a single extender sized to fit the openings allows for simplicity in forming a slab. The openings allow an extender to be inserted to extend the void and/or join used to create a foundation of any size or shape. For example in the case of 2 sized void forming elements in a 300mm and 225 mm height, the openings remain consistent so that the same extender can be utilized. In a further example a 300mm void element may be engaged with a 225mm void element.

Peripheral ribs 28 are in the illustrated form aligned as needed, for example they may be aligned about the edge of the module and also aligned to cross over in the centre.

In some forms, positioning an extender within the opening acts to strengthen the opening as an outer ridge of the opening is supported by the extender and engages the retainer to provide a strengthening rim. The extender acts to support the edge and also locks into place on the ridge. In some forms the ridge is curved or folded and extends around all or at least a portion of the periphery of the opening. In use, the void forming arrangement is selected such that the array 31 of void forming elements 11 forms a slab of the correct dimensions for the task. Adjacent void forming arrays or elements are joined through positioning the extender 40 in an opening 16 in peripheral sides of the void forming elements 11. The array 31 is extended where needed by positioning the extender in the opening Once concrete is poured and set, the void forming elements 11 create strengthening arches diagonally across the voids along with strengthening ribs and grooves on the upper surface of the voids or on the channel walls.

In some forms where a pipe or other obstacle extends across where the slab will be located, the void former can be extended to the edge of the obstacle by utilizing

the extender. The extender can extend the void forming element to the edge of the obstacle without requiring cutting of the void forming elements.

In some forms where a set down portion is required, different heights of void forming element can be used but these can be easily connected using the extender which is configured to join both void forming elements regardless of relative height. This allows for simplifying bathroom and other set down aspects while maintaining locked systems.

In some forms the void former of the present disclosure is composed of plastic.

The shape and configuration of the void forming arrangement has the benefit that it does not require accessories or independent spacers to space them apart by a specific distance and to create the ribs on the underside of the slab. The inbuilt strengtheners and ribs allow for use of a lighter plastic that still supplies sufficient strength. The supports within the channels provide support for bar positioned within the channels without requiring an independent chair or support. The openings in the void elements are sized and shaped to allow the extender to be used in void elements of various sizes. The extender may be used at various extensions levels from the void element with the ribs comprising an easy gauge of the distance the extender extends from the opening. The extender acts as both closer and extender.

For the purposes of transportation and storage, the pod forming elements 11 are stackable with one another and may be locked or engaged in position utilizing the locking ridge or curved lip around the edge of the openings. This slots into the locking ridge or curved lip of another oid forming unit. Because the heights of the openings are equivalent regardless of the height of the void forming element, void forming elements of variant heights can be stacked together and locked in place. The locking ridge strengthens the void forming elements during transport by providing additional support and strength at the edges of the opening.

Variations and modifications may be made to the parts previously described without departing from the spirit or ambit of the disclosure.

In the claims which follow and in the preceding description of the disclosure, except where the context requires otherwise due to express language or necessary implication, the word “comprise” or variations such as “comprises” or “comprising” is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the disclosure.

CLAIMS

1. A void forming arrangement for forming voids in a concrete slab, the arrangement comprising:

a void forming element comprising an upper surface supported by side support structures, the side support structures being located at the periphery of the upper surface and comprising at least one support wall, the side support structures and the upper surface defining a void;

the side support structures defining at least one opening into the void;

and, an extender configured to be inserted into the opening, the extender being configured to extend the void forming element and to close the opening.

2. A void forming arrangement for forming voids in a concrete slab, the arrangement comprising:

an array of void forming elements, as defined in claim 1 and one or more extenders as defined in claim 1.

3. A void forming arrangement as defined in claim 2, the arrangement further comprising a plurality of channels extending through the void forming arrangement, the channels being defined by channel walls and separating the void forming elements from adjacent void forming elements;

4. A void forming arrangement as defined in claim 2 or 3, wherein the void forming elements are oriented such that the openings are located on an outer edge of the arrangement.

5. A void forming arrangement as defined in any of the above referenced claims, wherein the extender includes:
an outer extender wall extending on at least three sides of the extender to define an interior extender passage extending through the extender; and,
a barrier acting to at least partially close the interior extender passage.

6. A void forming arrangement as defined in any of the above referenced claims, wherein the opening is sized such that the extender may be positioned and held therein.

7. A void forming arrangement comprising:
a plurality of void forming elements having two or more different heights,

the void forming elements comprising an upper surface supported by a plurality of support structures, at least one of the support structures defining an opening; and,

a plurality of extenders, the extenders being adapted to extend into and contact the opening in the support structures, the extenders adapted to extend the void forming element and to close the opening.

8. A void forming arrangement for forming voids in a concrete slab, the arrangement comprising:

an array of void forming elements,

a plurality of channels extending through the void forming arrangement, the channels being defined by channel walls and separating the void forming elements from adjacent void forming elements;

a bar support located within at least a portion of the plurality of channels for supporting a bar extending through the channels.

9. A void forming arrangement as defined in claim 8, the bar support being integrally formed with the void forming arrangement.

10. A void forming arrangement as defined in claim 8 or 9, the bar support having an upper profile with a depression located intermediate the void forming elements.

11. A void forming arrangement as defined in any one of the preceding claims, further comprising a strengthening element that extends diagonally across the upper surface of the void forming element.

12. A void forming arrangement as defined in any one of the preceding claims, wherein the strengthening element comprises a groove.

13. A void forming arrangement as defined in claim 12, wherein the strengthening element extends up the support structure.

14. A void forming arrangement as defined in any one of the preceding claims, the void forming arrangement including support structure which form channel walls, wherein the channel walls meet the upper surface at a curved profile.

15. A void forming arrangement as defined in any one of the preceding claims, further comprising one or more ribs extending across the upper surface.

16. A void forming arrangement as defined in claim 15, wherein one or more of the ribs extend substantially parallel with an edge of the void forming element, and wherein one or more of the ribs at an angle between 30 and 60 degrees with respect to the other ribs.

17. A void forming arrangement as defined in any one of the preceding claims, wherein the upper surface of each void forming element is substantially coplanar with the upper surface of at least some other void forming elements in the array.

18. A void forming arrangement as defined in any one of the preceding claims, wherein each arrangement is adapted to be engaged with an adjacent arrangement.

19. A void forming arrangement as defined in any one of the preceding claims, further comprising a pillar support extending downwardly from the upper surface within the periphery of the void forming element.

20. A void forming arrangement as defined in claim 18, wherein the pillar support is hollow.

21. A void forming arrangement as defined in any one of the preceding claims, comprising a strengthening element comprising two strengthening grooves substantially at right angles to one another.

22. An extender for a void forming arrangement, the extender comprising an elongate body, the body defining an interior passage extending through the extender and,
a barrier located within the interior passage.

23. An extender as defined in claim 21, wherein the body comprises a wall extending on at least three sides to define the interior passage.

24. An extender as defined in claim 22, wherein the wall has a ribbed outer surface.

25. An extender as defined in claim 22 or 23, wherein the wall includes a break extending around a portion of an outer surface of the body.

26. A method of forming a slab having voids, the method comprising:
selecting a plurality of void forming elements to form an array sized to form a slab, the plurality of void forming elements being selected from a group of void forming elements comprising at least void forming elements of a first size and void forming elements of a second size, at least a portion of the void forming elements including an opening extending through a wall of the void forming element;
positioning extenders in the openings to connect the void forming elements to form the array, the extenders being shaped to close the openings.

27. A method as defined in claim 25, wherein the openings have one size regardless of the size of the void forming elements.

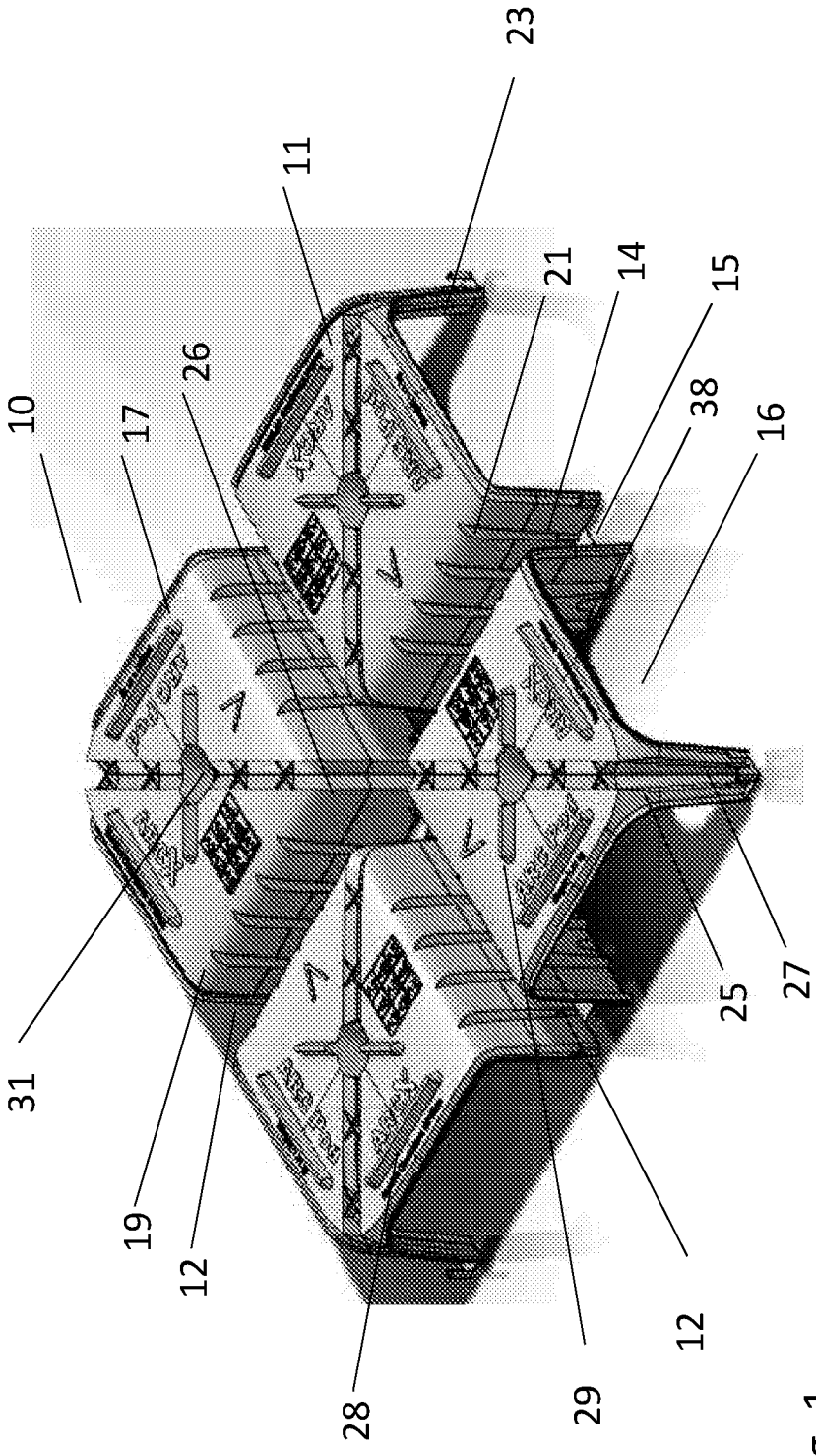


Fig. 1

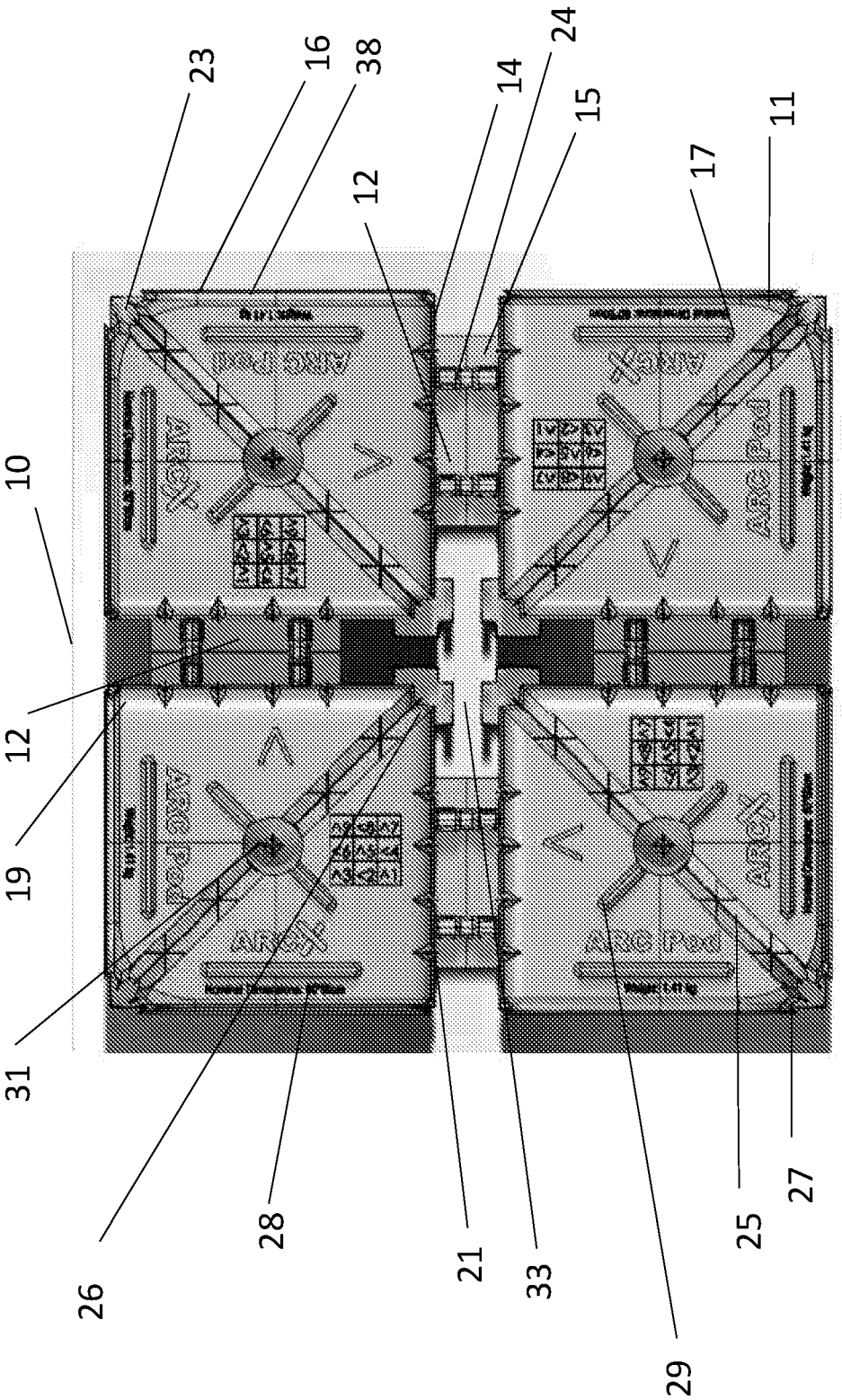


Fig. 2

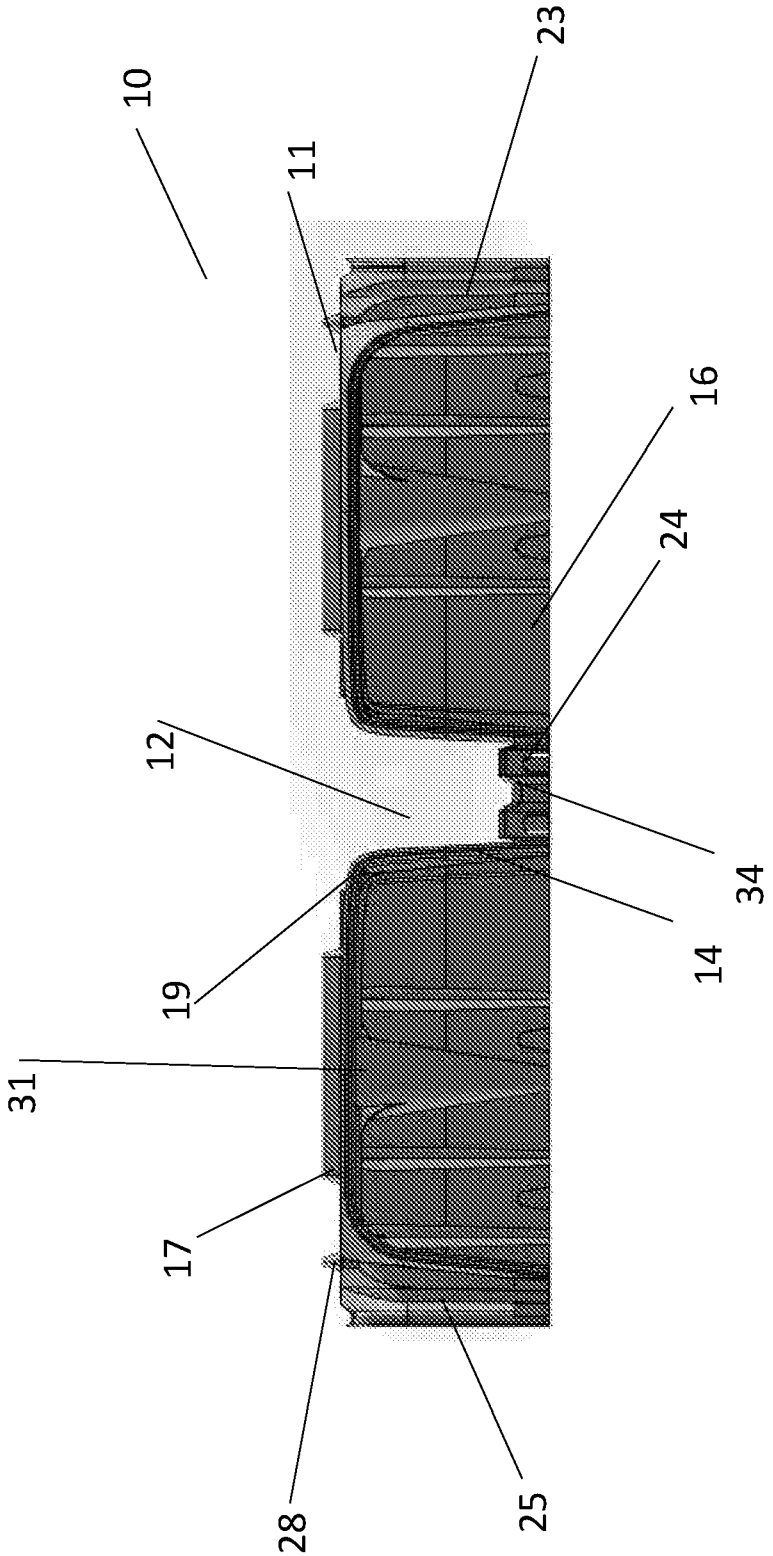


Fig. 3

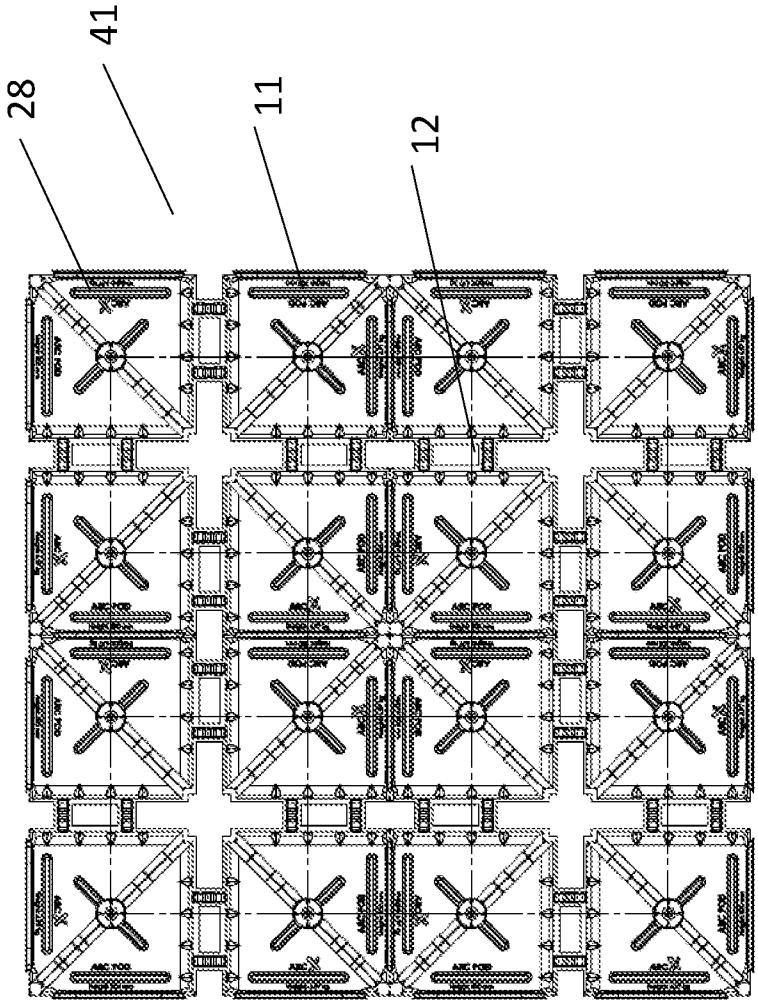


Fig. 4

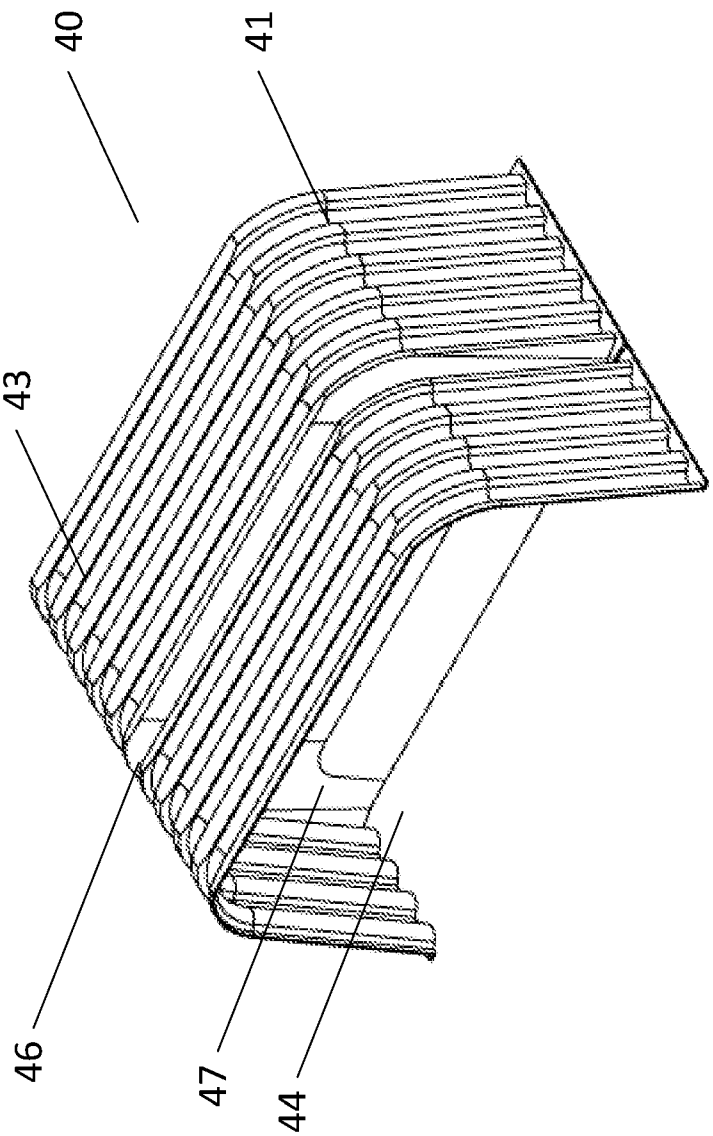


Fig. 5

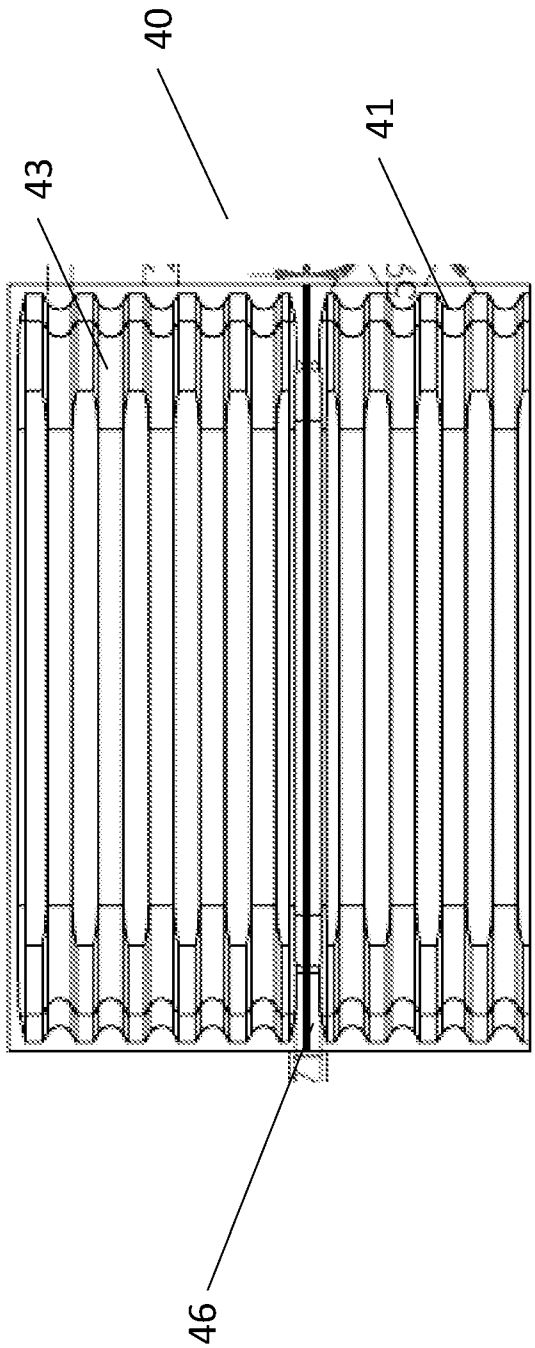


Fig. 6

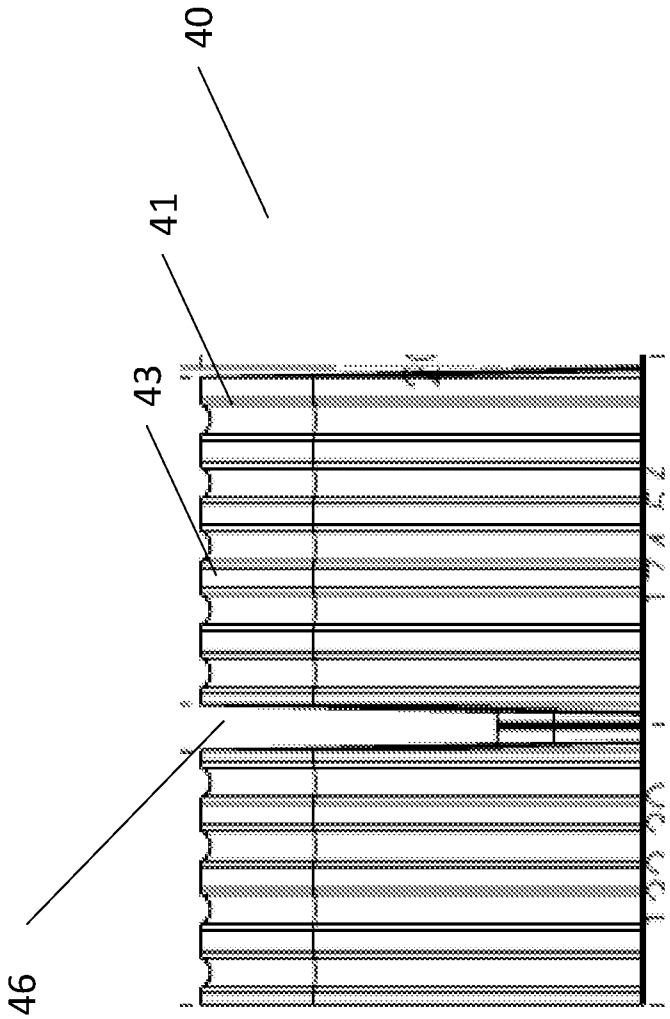


Fig. 7

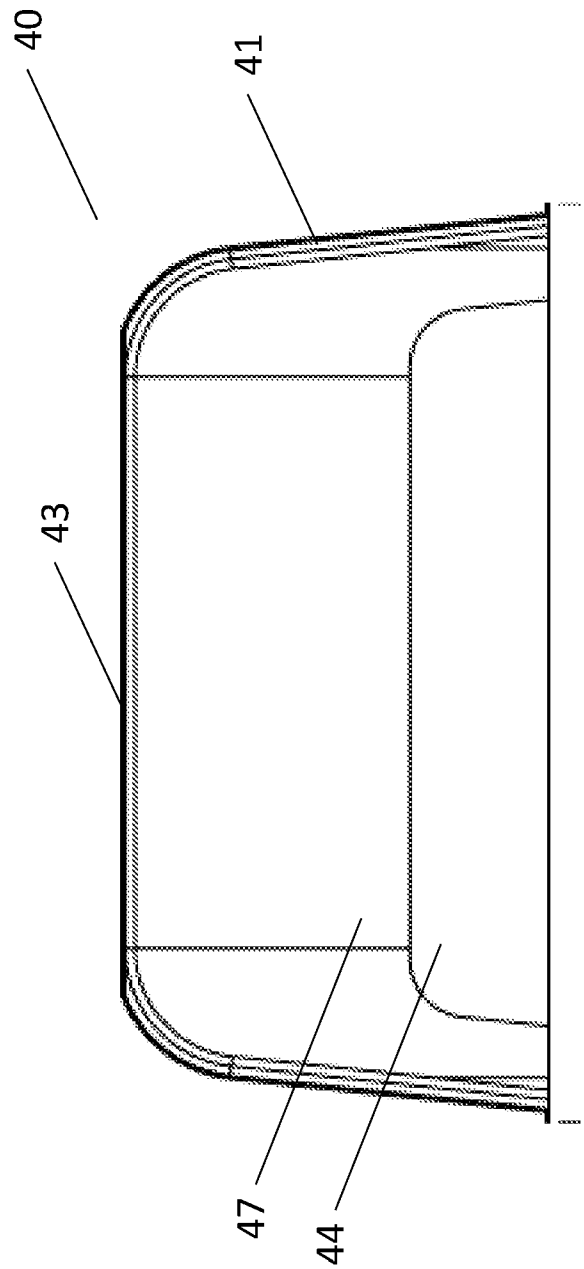


Fig. 8

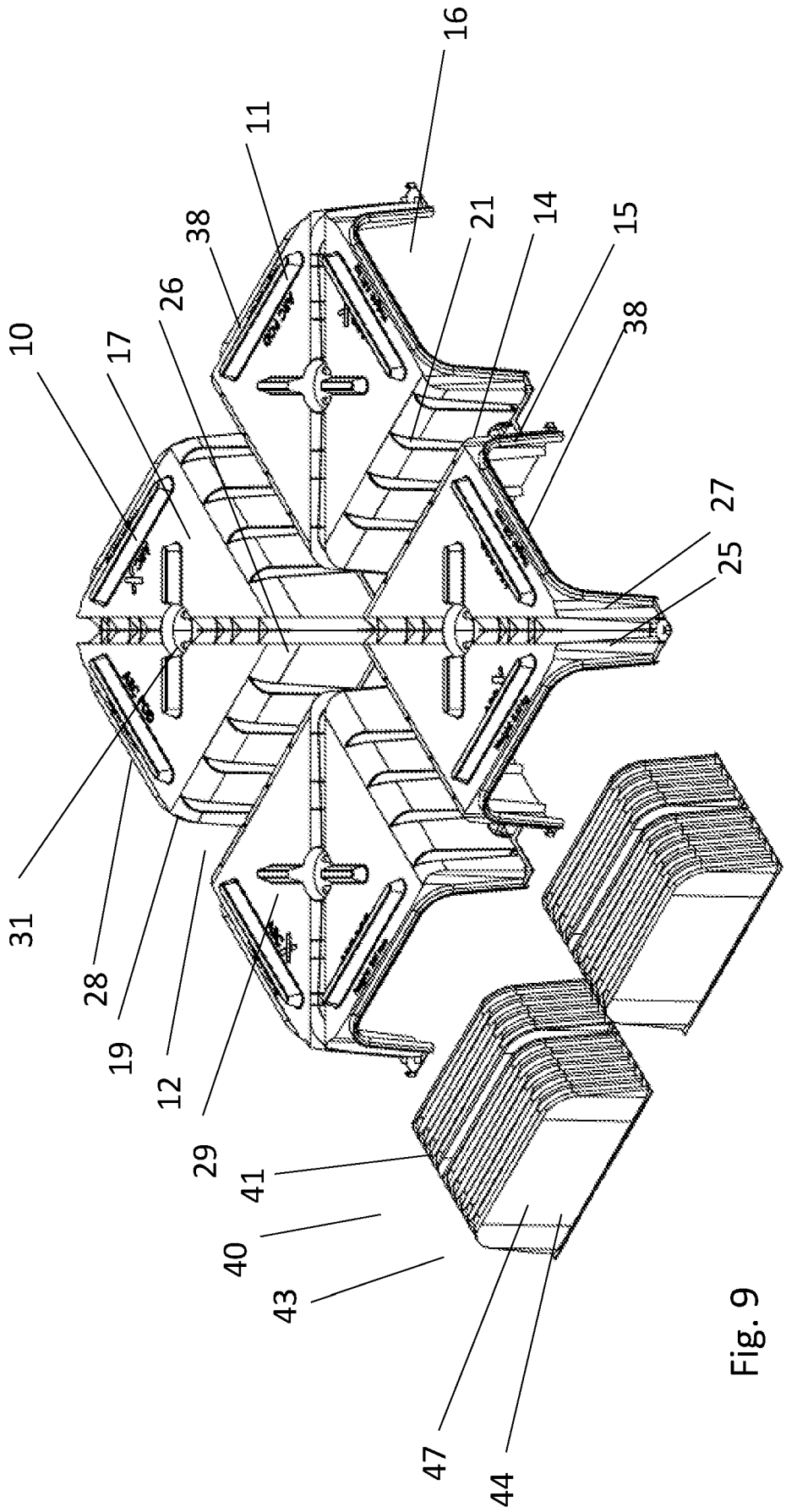


Fig. 9

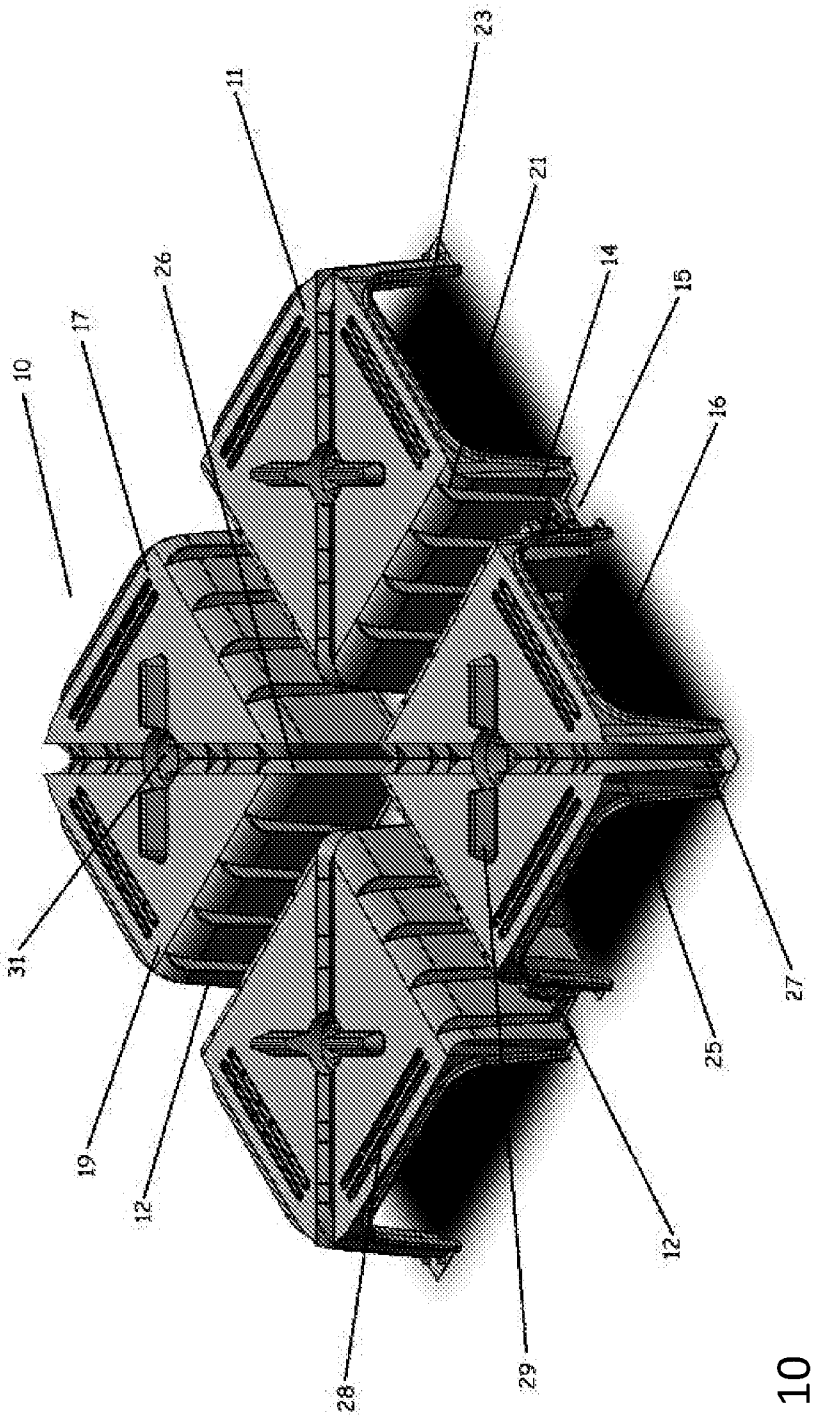


Fig. 10

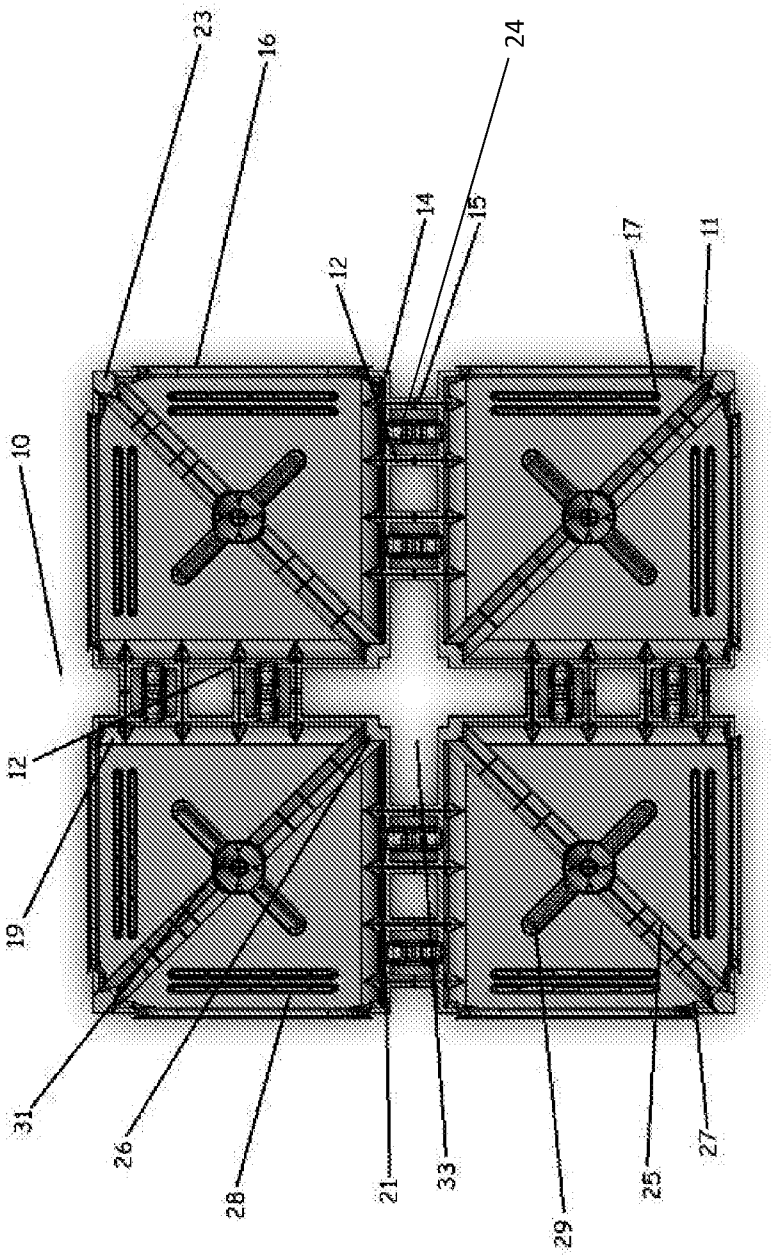


Fig. 11

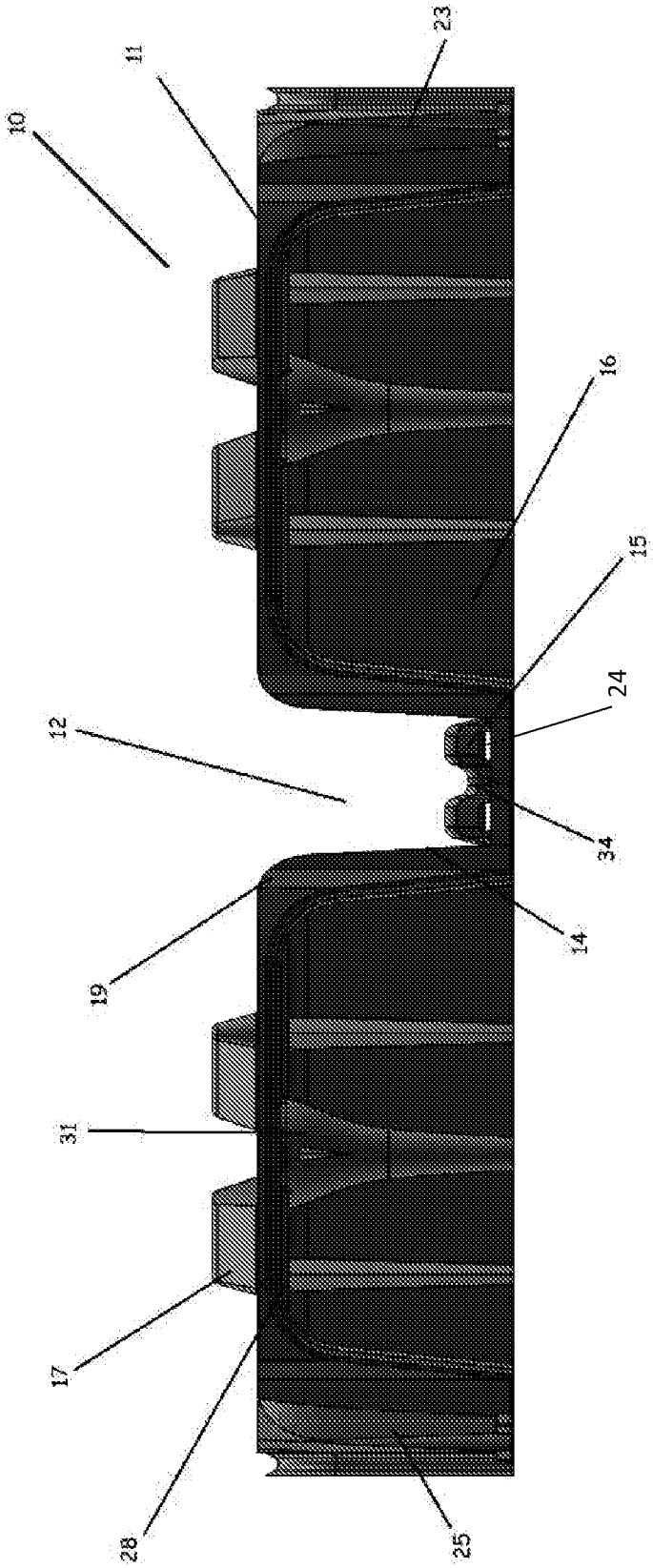


Fig. 12

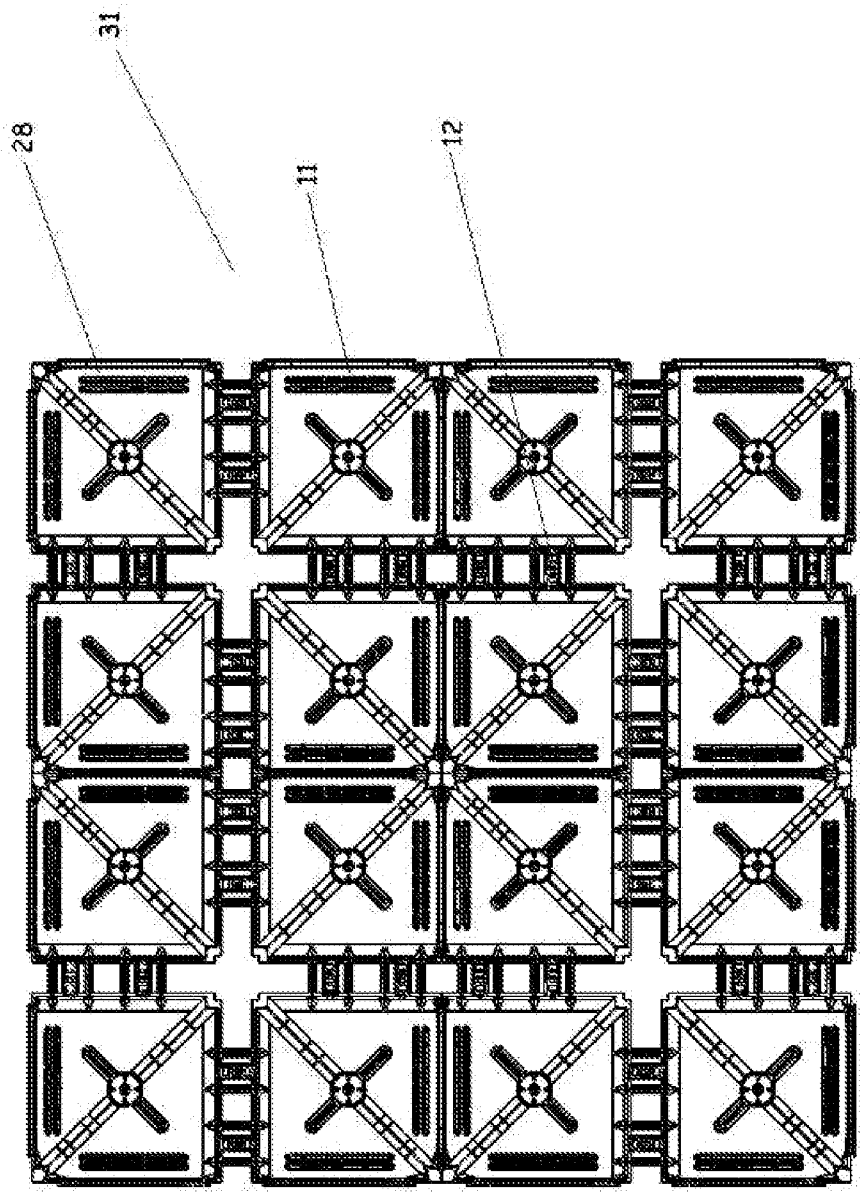


Fig. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2020/050225

A. CLASSIFICATION OF SUBJECT MATTER

E04G 11/46 (2006.01) E04B 5/32 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Epoque Internal, Espacenet & IP Australia internal databases: E04B5, E04B5/326, E04G11/46, E04G11/54, E04G9/02, Keywords(Void Former, Waffle pod, Cavity Former, Extender, Adaptor, Connect, Attach, Close, Cover, Barrier, Block, Divide, Compartment, Opening, Window, Bar, Rod, Tie, Re-bar, Pillar, Post, Hollow, Cylindrical, Vary, Differ, Height, Size, Dimension, Intermediate, Middle, Interior and similar terms), Combi on cited documents & Applicant and Inventor name search.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 June 2020	02 June 2020

Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Pascar Chitsaka AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262832130

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2020/050225**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1282750 A1 (PONTAROLO, VALERIO) 12 February 2003 Fig 3-5 & Para[0027]	1-7
X	EP 1564343 B1 (GEOPLAST S P A) 18 November 2015 Fig 3 & Para [0025]	1 & 26-27
X	GB 1034607 A (HERMANN HANEKAMP) 29 June 1966 Fig 4, 8 & 12	1, 8
X	FR 1564343 A (EUROP FINANCIERE D ETUDES ET D) 30 April 1965 Fig 2	1
X	WO 2005/108701 A1 (AUSTRALIAN STEEL COMPANY (OPERATIONS) PTY LTD) 17 November 2005 Fig 2-3, 6 & Page 6 line 23, 8 lines 1-5, Page 9 lines 10-13	8-10 & 17-20
X	WO 2005/061804 A1 (AUSTRALIAN STEEL COMPANY (OPERATIONS) PTY LTD) 07 July 2005 Fig 3 & Para [0025]	8
X	WO 00/52279 A1 (PONTAROLO, Valerio) 08 September 2000 Fig 2b, 9-11 & Page 10 line 31-Page 11 line 2	8, 11-16 & 21
X	WO 2008/071249 A1 (PONTAROLO ENGINEERING S.P.A.) 19 June 2008 Fig 1-3	8
X	KR 101781968 B1 (TVS FORUM CO LTD) 19 June 2008 Fig 2b & English description Machine Translated by EPO	22-25

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2020/050225

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

Supplemental Box

Continuation of: **Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-7, 26-27 & (11-21 in part) are directed to a void forming arrangement and a method of forming a slab having a void.. The feature of extender(s) configured to be inserted into the opening, the extender(s) being configured to extend the void forming element and to close the opening is specific to this group of claims.

- Claims 8-10 (11-21 in part) are directed to a void forming arrangement.. The feature of a bar support located within at least a portion of the plurality of channels for supporting a bar extending through the channels is specific to this group of claims.

- Claims 22-25 are directed to an extender for a void forming arrangement.. The feature of a barrier located within the interior passage is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

Note that claim 23 is appended to claim 21, this appears to be in error. Therefore I have considered claim 23 as appended to claim 22 which is directed to an extender

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a priori*.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2020/050225**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
EP 1282750 A1	12 February 2003	EP 1282750 A1	12 Feb 2003
		EP 1282750 B1	14 Jan 2004
		AU 5248001 A	26 Nov 2001
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		AU 2005240674 B2	21 Oct 2010
		US 2008035830 A1	14 Feb 2008
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		AU 2004303436 A1	07 Jul 2005
		AU 2004303436 B2	24 Mar 2011
		US 2007214740 A1	20 Sep 2007

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2020/050225**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
WO 00/52279 A1	08 September 2000	WO 0052279 A1	08 Sep 2000
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		KR 101781969 B1	23 Oct 2017
		WO 2018135802 A1	26 Jul 2018

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.