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(54) Process of constructing a basin for a swimming pool and wall elements therefore

(57) Process of constructing a swimming pool basin, comprising:

(i) preparing a site for said swimming pool basin;
(ii) erecting on said site a plurality of pre-fabricated wall elements (10, 40) of foamed plastic for establishing a basin wall pre-structure, each wall element having a length corresponding essentially to the depth of said swimming pool basin; said wall elements providing said pre-structure with pillar-shaped passages (12, 42) extending from top to bottom through said pre-structure;
(iii) pouring concrete into the pillar-shaped passages of said pre-structure, thereby forming a plurality of discrete, spaced concrete pillars in said pre-structure;

said concrete pillars providing mechanical stability and said wall elements providing heat-insulation to said basin wall.

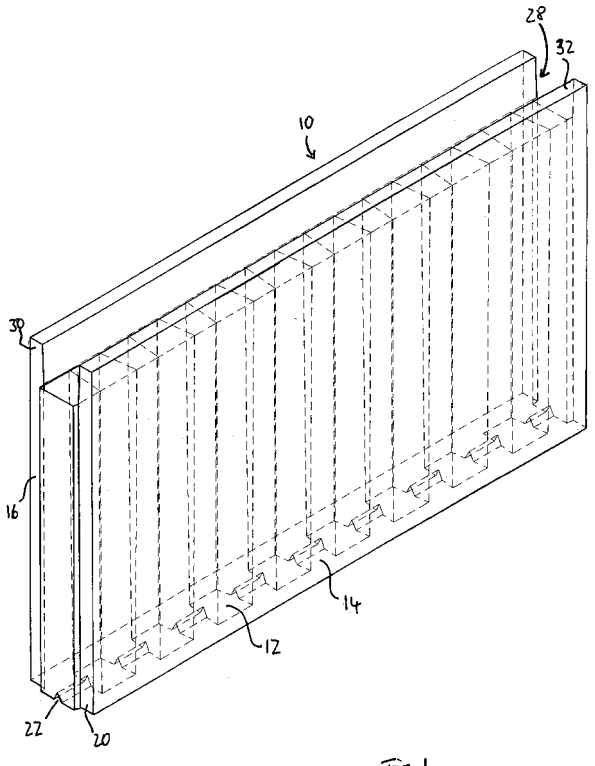

Fig. 1

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Description

[0001] This invention provides a process of constructing a swimming pool basin. This invention also provides a swimming pool obtained by said process. The invention also provides pre-fabricated wall elements for constructing a swimming pool basin.

[0002] The sidewalls of a swimming pool basin typically consist of concrete and are constructed using formwork. Polypropylene is another material known to be used in sidewalls of swimming pool basins. Neither concrete nor polypropylene can provide a satisfactory heat-insulation, resulting in high costs for keeping swimming pool water at a temperature above ambient temperature. Further, the construction of concrete sidewalls of a swimming pool basin is time consuming and requires many working steps like constructing the formwork, pouring concrete in the formwork, and demounting the formwork etc.

[0003] In the construction of residential buildings, insulated concrete forms or ICFs have recently been introduced. In this technology, walls are constructed from panels made of expanded polystyrene and concrete. The panels are erected at a distance that corresponds to the thickness of the wall. Ties between the panels keep the panels at a fixed distance. Concrete is then poured in between the panels, whereby the panels are used as formwork. As a result, walls having a 3-layer structure and good heat insulation properties are obtained. ICF systems are commercially available e.g. the Quad-Lock-System (www.quadlock.com).

[0004] The known ICF system is, however, has disadvantages and is not suited for constructing swimming pools. First, many ties have to build in between the panels in order to prevent that the panels are pressed apart when heavy concrete is poured in between the panels. Second, known ICF systems are designed for the static circumstances of buildings, where walls have to stand a high pressure from upper building parts. Therefore, walls have to be very strong and concrete consumption is still high. Third, heat insulation of known ICF systems may be satisfactory for buildings where heat is mainly transported to and from walls by air. In a swimming pool, however, heat is transported to the walls by water which has a much higher heat conductivity and heat capacity than air. Therefore, the insulation properties of known ICF systems is not satisfactory for a swimming pool.

[0005] It is therefore an object of the invention to provide a simple and rapid process of constructing a swimming pool basin, whereby the sidewalls of the swimming pool basin provide good heat-insulation to the sidewalls and whereby concrete consumption is reduced.

[0006] This object has been achieved by a process of constructing a swimming pool basin, comprising:

(i) preparing a site for said swimming pool basin;
(ii) erecting on said site a plurality of pre-fabricated wall elements of foamed plastic for establishing a basin wall pre-structure, each wall element having a length corresponding essentially to the depth of said swimming pool basin; said wall elements providing said pre-structure with pillar-shaped passages extending from top to bottom through said pre-structure;
(iii) pouring concrete into the pillar-shaped passages of said pre-structure, thereby forming a plurality of discrete, spaced concrete pillars in said pre-structure;

said concrete pillars providing mechanical stability and said wall elements providing heat-insulation to the wall of said basin.

The invention also provides a swimming pool basin obtainable according to the process of the invention. Further, the invention provides wall elements of foamed plastic for the process of the invention.

[0007] Surpisingly, a process has been found for rapidly constructing a heat-insulated swimming pool basin using the wall elements of the invention. These wall elements function as formwork for contructing a concrete framework and, at the same time, as a heat-insulator. Further, ties that keep opposing panels of expanded polystyrene (EPS) at a fixed distance are not needed, since the foamed plastid material in between said pillar-shaped passages perform the function of the ties. Thus, construction is easier and faster compared to known ICF systems. Moreover, heat insulation is improved and conrete consumption is reduced, while stability of the basin sidewalls against the hydrostatic pressure of swimming pool water is sufficient.

[0008] In step (i) of the process of the invention, a site for said swimming pool is prepared. If the swimming pool basin to be constructed is at least partially below the ground surface, said preparing may comprise making an excavation. For an above-ground swimming pool basin, said preparing may be planing or laveling the ground. If the depth of the swimming pool basin is not constant but varies along a length of the basin, said site for said swimming pool basin may be inclined accordingly. If desired, the surface of said prepared site may be tamped and provided with stoning to provide a suitable base for said swimming pool basin.

[0009] In step (ii) of the process of the invention, said pre-structure is constructed by erecting on said site a plurality of said pre-fabricated wall elements of foamed plastic. Preferably, said wall elements are placed on blocks like concrete blocks 82 (Fig. 9) for elevating the wall element 5 to 20 cm, preferably 10 to 15 cm, above the surface of said site. Said blocks are preferably placed at a location where neighboring wall element abut each other such that one block supports the ends of two wall elements. Said wall elements are placed adjacent to each other, preferably such that an even surface at the inner side of said swimming pool basin is created. For achieving a tight fit between neighboring wall elements, said wall elements preferably have means for establishing a

form-fit like protrusions 26 and 56 that can establish a form-fit together with recesses 24 or 54 of a neighboring wall element.

[0010] Said wall elements are pre-fabricated and are made of foamed plastic. The foamed plastic should be watertight. As shown in Fig. 2 said wall elements typically have peripheral portions, namely an inner wall portion 20 and an outer wall portion 16. Said wall elements have a middle portion 18 where said pillar-shaped passages 12 and intervening foamed plastid portions 14 are found and may alternate. The peripheral portions typically have a thickness of 3 to 8 cm, preferably 4 to 6 cm. The middle portion typically has a thickness of 12 to 20 cm, preferably 14 to 17 cm (cf. Fig. 2). Most preferred dimensions of wall elements and pillar-shaped passages are given in the figures. The configuration and material of said wall elements is chosen such that the wall elements provides sufficient mechanical stability to said pre-structure during the process of pouring concrete into said pillar-shaped passages. Further, the pillar-shaped passages of the wall elements are dimensioned such that the concrete pillars are of sufficient stability for the particular basin to be constructed (see below). A preferred material for said wall elments is extended polystyrene (EPS), notably closed cell EPS. The density of the EPS is preferably at least 20 kg/m^3, more preferably at least 25 kg/m^3 most preferably at least 30 kg/m^3. Each wall element is preferably made by foaming in a mold, whereby the shape and all surface features can be easily obtained. Thus, each wall element is preferably constructed as a single piece. Methods of creating bodies of any shape e.g. by forming in a mold are known in the art (see Ullman's Encyclopedia of Industrial Chemistry (2003) Vol. 14, 553-555 and references cited therein).

[0011] The wall elements of the invention have a length that corresponds essentially to the predetermined depth of said swimming pool basin. Thus, it is not necessary to place several wall elements on top of each other for reaching the predetermined height of a sidewall of the basin. Regarding the depth of the basin, the invention is not limited and may be in the range of 0.5 to 3 m, preferably 1.0 to 2.0 m. The other lengths of said wall element like that becoming the length in horizontal direction when said wall elements are erected may vary and may be adjusted to the overall size and shape of the pre-structure. In the case of a linear wall element, this length may be in the range of 1 to 3 m, preferably 1.5 to 2.5 m.

[0012] Said wall elements provide said pre-structure with pillar-shaped passages extending from top to bottom through said pre-structure. Said pillar-shaped passages are filled with concrete after said pre-structure has been constructed and thus provide, after setting of the concrete, concrete pillars that provide strength to the swimming pool basin. Neighboring wall elements may have recesses at the faces where neighboring wall elements abut each other when erected adjacent to each other, whereby a pillar-shaped passage may be formed by two wall elements. Preferably, each wall element has at least one pillar-shaped passage in said wall element (cf. Fig. 2). A wall element may have several (i.e. two, three or more) pillar-shaped passages depending on the length of said wall element (in horizontal direction after erecting the wall element). Several pillar-shaped passages in the pre-structure or in a wall element are spaced by intervening foamed plastic material (cf. protions 14 in Fig. 2). After erecting the wall element, said pillar-shaped passages extend from top to bottom, essentially in vertical direction. Said pillar-shaped passages extend completely through said wall element and are open at both ends for allowing pouring in of concrete at the top and enabling a contact of poured concrete with base material at the bottom.

[0013] The cross-sectional shape and size of said pillar-shaped passages have to be determined such that the purpose of providing sufficient strength to the swimming pool basin can be attained. An architect or civil engineer can determine the size and shape of, preferably steel reinforced, concrete pillars required for a particular swimming pool basin using his general knowledge. The concrete pillars are adapted for withstanding the hydrostatic pressure of water in said basin. The higher, in the middle region 18 of a wall element, the cross-sectional areas (viewed as in Fig. 2) of the pillar-shaped passages compared to the cross-sectional areas of the intervening foamed plastic portions 14, the higher the stability of the concrete pillars and the lower the heat insulation of the wall element. The lower the cross-sectional areas (viewed as in Fig. 2) of the pillar-shaped passages compared to the cross-sectional areas of the intervening foamed plastic portions 14, the lower is the stability of the concrete pillars and the higher is the heat insulation. Therefore, a satisfactory ratio of said cross-sectional areas has to be found depending on the circumstances of the case. Preferably, the cross-sectional area of the pillar-shaped passages (in the top view of Fig. 2) in the middle portion of said wall element is 40 to 80%, more preferably 50 to 70%, and most preferably 55 to 65%, whereby the remainder of the cross-sectional area is occupied by the intervening foamed plastic portion 14.

[0014] The horizontal cross-section (seen in the view of Fig. 2) of the pillar-shaped passages may be angular or elliptical (e.g. circular). Preferred angular cross-sections are trapezium-like (as shown in Fig. 2) or rectangular. In the case of a square cross-section, the length of the edges of the square may be in the range of 10 to 20 cm. The most preferred cross-sectional shape of the pillar-shaped passages is trapezoid as shown in Fig. 2. In this case, the trapezoid side having the larger dimension is oriented to the inside of the swimming pool basin, since this results in high stability for withstanding the hydrostatic pressure exerted on the wall by swimming pool water.

[0015] Said wall elements preferably have a U-shaped recess like recess 28 of Fig. 3 along the top side of said wall elements, said recess extending along the top side of said pre-structure. Said U-shaped recess is adapted

to be filled with concrete for forming an upper horizontal concrete beam resting on said concrete pillars. The upper horizontal concrete beam achieves a solid, stable upper bordering of said basin.

[0016] The shape of the pre-structure of the invention determines the shape of the swimming pool basin to be constructed. The wall elements of the invention allow to construct a swimming pool basin of any shape desired. The shape of the swimming pool basin may be circular or angular, whereby such shapes may be combined to build irregular shapes of a swimming pool basin. The shape of the wall elements can be adjusted to the shape of said basin. The overall shape of the wall elements may be curved as those shown in Fig. 10. Preferably, however, the shape of the basin is angular (preferably rectangular) and the corresponding pre-structure is constructed from wall elements having an overall linear shape. In the case of an angular basin, angles in the pre-structure may be formed by linear wall elements abutting each other at the predetermined angle. Preferably, angles in the pre-structure are constructed using corner wall elements as those shown in Fig. 5. A corner wall element has two legs at the predetermined angle of the corner to be built. Each leg may have one or more pillar-shaped passages according to the invention.

[0017] After erecting said pre-structure, concrete is poured in step (iii) into the pillar-shaped passages of said pre-structure, thereby forming a plurality of discrete, spaced concrete pillars in said pre-structure. Said concrete pillars provide mechanical stability and said wall elements providing heat-insulation to said basin wall. With said pillar-shaped passages, the pre-structure determines the concrete structure of the sidewalls of said swimming pool basin. Then, concrete is poured in the U-shaped recess of said pre-structure, whereby, after setting, a concrete framework is obtained.

[0018] For providing sufficient stability to said swimming pool basin, steel reinforced concrete should be used in said concrete pillars. Preferably, steel reinforced concrete is also used for said upper horizontal concrete beam in said U-shaped recession. Reinforced concrete is preferably also used as a stable base under said wall elements. More preferably, the entire area of said basin should have a base of reinforced concrete. Most preferably, the entire concrete structure of said basin is a structure of reinforced concrete, said structure comprising a reinforced concrete base for said concrete pillars under said wall elements, reinforced concrete pillars, and horizontal beams of reinforced concrete resting on the concrete pillars. Said structure preferably further comprises a base plate of said swimming pool basin made of reinforced concrete. The reinforcing steel used for the various concrete parts should be connected with each other before pouring concrete for achieving a stable structure of reinforced concrete.

[0019] A preferred process of constructing said swimming pool basin of the invention is as follows. After having prepared the site for said basin, steel mattresses are placed on said site, whereby the area covered with steel mattresses should be larger than the base of said basin (cf. Fig. 10). Next, said pre-structure is constructed from said pre-fabricated wall elements, whereby said wall elements are placed on blocks 82 providing a free space between the ground of said site and the bottom edge of said wall elements. Then, reinforcing steel is applied along the bottom of said wall elements in grooves 22 and 52 of said wall elements, in said pillar-shaped passages, and in said U-shaped recess. The reinforcing steel parts are applied such that the steel parts in the U-shaped recess at the top of the wall elements are connected to a steel mattress at the bottom of said basin via reinforcing steel in said pillar-shaped passages. These steps may be carrried out on a first day of construction. On a second day of construction, concrete is delivered to the construction site by a concrete truck. Concrete is then poured into the free space under the wall elements for forming a base for said concrete pillars. Then, concrete is poured into said pillar-shaped passages. Next, concrete is poured into said U-shaped recession at the top of said pre-structure. Finally, the base plate of the basin is formed by pouring concrete on the steel mattresses inside in the area surrounded by the sidewalls of the basin, whereby the swimming pool basin of the invention is obtained. For an average sized private swimming pool basin, the concrete work can be accomplished within 3 hours. Thus, the swimming pool basin of the invention may be constructed within 2 days.

[0020] A water inlet, a water outlet, filtering devices, pumps, heating devices of heating swimming pool water may be mounted as desired. The surface of the wall elements or concrete surfaces may then be treated for achieving a more appealing appearance e.g. by painting, coating, tiling of walls or floors etc. Further, anti-fouling agents as generally used for swimming pools may be applied to surfaces that are in contact with swimming pool water.

Brief Description of the Figures

[0021]

Fig. 1 is a perspective view on a linear wall element 10. Wall element 10 is made of foamed polystyrene (EPS) and may be prepared by foaming in a mold as a single piece. Wall element 10 has eight pillar-shaped passages 12 extending from top to bottom. The pillar-shaped passages 12 are spaced by portions 14 of foamed polystyrene. Wall element 10 has outer wall portion 16 and inner wall portion 20. Outer wall portion 16 is oriented to the outside of said basin after construction of the pre-structure. Inner wall portion 20 is oriented to the inner side of said basin after construction of the pre-structure. Each pillar-shaped passage 12 is limited by two portions 14, by inner wall portion 20, and by outer wall portion 16. Invisible edges are indicated by dashed lines. Groove 22 pro-

vides space for reinforcing steel in the form of a steel rod or stell mesh that can be inserted along the length of said wall element 10 in said groove 22. The top portions 30 and 32 of outer wall portion 16 and inner wall portion 20, respectively, form a U-shaped recess 28 at the top of wall element 10.

Fig. 2 shows a top view on wall element 10 of Fig. 1. In the left-hand drawing, dimensions are given in cm. In the right-hand drawing, the same wall element is shown without dimensions. The cross-section of the pillar-shaped passages 12 have the shape of a trapezium. Portions 14 separate pillar-shaped passages such that the pillar-shaped passages are discrete and uniformly spaced from each other. Surface 11 of outer wall portion 16 will point towards the outside of the swimming pool basin. Surface 13 of the inner wall portion 20 will point towards the inside of the swimming pool basin, whereby the longer edges of trapezium-shaped passages 12 point towards the inside of the basin to be constructed. Inner wall portion 20 and outer wall portion 16 enclose a middle portion 18 with pillar-shaped passages 12 and portions 14 that separate the pillar-shaped passages from each other. Wall element 10 has a recess 24 at one end for receiving a protrusion 26 from a neighboring wall element when said pre-structure is constructed. Wall element 10 further has a protrusion 26 at the opposing end capable of being received by a recess 24 from a neighboring wall element. Recess 24 and protrusion 26 thus provide a form-fit to neighboring wall elements when said pre-structure is constructed.

Fig. 3 shows a side view of the linear wall element 10 shown in Fig.1 and 2. In the right-hand drawing, dimensions are given in cm. In the left-hand drawing, the same wall element without dimensions is shown. The vertical dashed lines indicate the central portion of the wall element that is enclosed by outer wall portion 16 and inner wall portion 20. Wall element 10 has a U-shaped recess 28 on the top side of the erected wall element. U-shaped recess 28 is adapted to be filled with concrete. Said U-shaped recess 28 is enclosed by upper part 30 of inner wall portion 20 and by upper part 32 of the outer wall portion 16.

Fig. 4 shows a front view onto surface 11 of wall element 10. Dashed lines indicate hidden edges of said pillar-shaped passages 12. The wall element has a length of 2.0 m and an overall height of 1.22 m. The pillar-shaped passages have a length of 1.08 m.

Fig. 5 is a perspective view on a corner wall element 40. Dashed lines indicate hidden edges. Said corner wall element has two legs 43 and 44 at an angle of 90°. In each leg, there is provided a pillar-shaped passage 42. Said corner wall element has outer wall portions 70 and 71 and an inner wall portion 66 that has a curved surface and pertains to both legs of the corner wall element. The upper portions 72 and 73 of outer wall portions 70 and 71, respectively, provide, together with upper portion 67 of curved inner wall portion 66, a U-shaped recess on the top side of said corner wall element. At the bottom of the corner wall element, there is provided groove 52 having a triangluar crossection in the leg portions of the corner wall element. Recess 52 extends along both legs at the bottom of the corner wall element. In corner 53 of groove 52, groove 52 enlarges to abridge the way of groove 52, allowing a reinforcing steel rod to run smoothly around corner 53 without having to impose too much strain to said reinforcing steel rod. Corner wall element 40 has a recess 54 at the right-hand leg for receiving a protrusion 26 from anotherwall element, e.g. from linear wall element 10. Corner wall element 40 has a protrusion 56 at the left-hand leg capable of being received by recess 24 of another wall element, e.g. from linear wall element 10. Recess 54 and protrusion 56 thus allow a form-fit with neighboring wall elements. The U-shaped recess of corner wall element 40 will be aligned with U-shaped recess 28 of linear wall element 10, when wall elements 10 and 40 are erected adjacent to each other such that protrusion 56 and recess 24 (or such that recess 54 and protrusion 26) establish a form-fit. Similarly, grooves 22 and 52 will align.

Fig. 6 shows a view on the bottom of corner wall element 40 shown in Fig. 5. The top drawing shows preferred dimensions in meter. At the bottom, the same corner wall element without dimensions is shown.

Fig. 7 shows a view (as indicated in Fig. 6 with arrow A) towards the face of the right-hand leg of corner wall element 40 shown in Fig. 5. Dashed lines show hidden corners or edges. Dimensions are given in meter.

Fig. 8 shows corner wall element 40 in the same perspective as seen in Fig. 5, whereby the pillar-shaped passages have been filled with concrete shown in gray. The concrete shown in the pillar-shaped passages forms concrete pillars 80. Concrete poured into said U-shaped recesses forms horizontal concrete beam 82 that rests on concrete pillars 80.

Fig. 9 sketches a pre-structure of linear wall elements and corner wall elements after having performed step (ii) of the process of the invention. The wall elements rest on concrete blocks 82. Concrete blocks 82 are positioned at locations where neighboring wall elements abut each other. In this way,

each concrete block 82 supports the end of two wall elements. The pillar-shaped passages 12 and portions 14 separating pillar-shaped passages are schematically indicated. A reinforcing steel rod 91 running through groove 22 in linear wall elements and groove 52 of corner wall elements is indicated. Said concrete blocks 82 lift the wall elements up from the ground such that the wall elements do not touch the ground, leaving a free space between the ground and the bottom of the wall elements. The free space can be filled with concrete for providing a solid base for said concrete pillars.

Fig. 10 shows a pre-structure of wall elements erected on a reinforcing steel mattress 92. The pre-structure was constructed by first preparing a leveled site for said swimming pool basin. Then, a reinforcing steel mattress 92 was placed on said site. Next, the pre-structure of the invention was constructed on concrete blocks 82 from linear wall elements 94 and corner wall elements 96. Reinforcing steel rods are inserted into the pillar-shaped passages and connected at the bottom with the reinforcing steel mattress. Reinforcing steel is also inserted into said U-shaped recess 28 and connected with the reinforcing steel in said pillar-shaped passages.

Fig. 11 shows a swimming pool according to the invention made from the pre-structure of Fig. 10. Starting from the stage shown in Fig. 10, concrete 97 was poured into the free space under the wall elements. Then, concrete was poured into said pillar-shaped passages, whereby the wall elements function as formwork for said concrete. After setting, concrete in said pillar-shaped passages forms concrete pillars. Concrete 98 is then poured into said U-shaped recess 28 at the top of said wall elements. The weight of the concrete in said U-shaped recession rests on said concrete pillars. Finally, concrete was poured inside the swimming pool basin, forming the concrete base plate 99 of the basin. After setting of the concrete, the reinforced concrete of the swimming pool basin forms a single stable reinforced concrete structure.

Claims

1. Process of constructing a swimming pool basin, comprising:

   (i) preparing a site for said swimming pool basin;
   (ii) erecting on said site a plurality of pre-fabricated wall elements (10, 40) of foamed plastic for establishing a basin wall pre-structure, each wall element having a length corresponding essentially to the depth of said swimming pool basin; said wall elements providing said pre-structure with pillar-shaped passages (12, 42) extending from top to bottom through said pre-structure;
   (iii) pouring concrete into the pillar-shaped passages of said pre-structure, thereby forming a plurality of discrete, spaced concrete pillars in said pre-structure;

   said concrete pillars providing mechanical stability and said wall elements providing heat-insulation to said basin wall.

2. The process according to claim 1, wherein the configuration and material of said wall elements is chosen such that the wall element provides sufficient mechanical stability to said pre-structure during the process of pouring concrete into said pillar-shaped passages.

3. The process according to claim 1 to 2, wherein each wall element has a plurality of said pillar-shaped passages.

4. The process according to any one of claims 1 to 3, wherein said wall elements are erected on blocks (82) providing a free space between the ground of said site and the bottom side of said wall elements, said free space to be filled with concrete, preferably with reinforced concrete.

5. The process according to any one of claims 1 to 4, wherein step (ii) comprises erecting and adjoining linear wall elements, thereby providing an angular, preferably rectangular, shape of said pre-structure.

6. The process according of one of claims 1 to 5, wherein a corner wall element (40) is used for constructing a corner of said pre-structure, said corner wall element having two legs at the angle of the corner to be built.

7. The process according to any one of claims 1 to 6, wherein said site is provided, after step (i), with reinforcing steel, preferably a steel mattress, for reinforcing a concrete base plate of said swimming pool basin.

8. The process according to any one of claims 1 to 7, wherein said pillar-shaped passages are equipped with reinforcing steel for reinforcing said concrete of said concrete pillars, whereby said reinforcing steel of said pillar-shaped passages is preferably linked with reinforcing steel of a base plate of said swimming pool basin.

9. The process according to one of claims 1 to 8, wherein said wall elements have a U-shaped recess (28) on the top side of said erected wall elements, said

recess extending along the top side of said pre-structure, and wherein concrete is poured after step (iii) into said U-shaped recess, thereby forming an upper horizontal concrete beam resting on said concrete pillars.

10. The process according to one of claims 1 to 9, wherein a base plate of said swimming pool basin is formed of concrete.

11. The process according to claim 1 to 10, wherein said pre-fabricated wall elements are made of foamed (expanded) polystyrene.

12. The process according to claim 11, wherein said wall elements are produced by foaming in a mold.

13. The process according to any one of claims 1 to 12, wherein the cross-section of said pillar-shaped passages when viewed from top to bottom is trapezoid.

14. Swimming pool basin obtainable according to the process of any one of claims 1 to 13.

15. Wall element of foamed plastic for constructing a sidewall of a swimming pool basin, having at least one pillar-shaped passage extending through said wall element as defined in any one of claims 1 to 13.

16. Wall element according to claim 15, wherein said wall element has two legs at an angle of a corner to be formed, each leg having at least one pillar-shaped passage extending through said wall element.

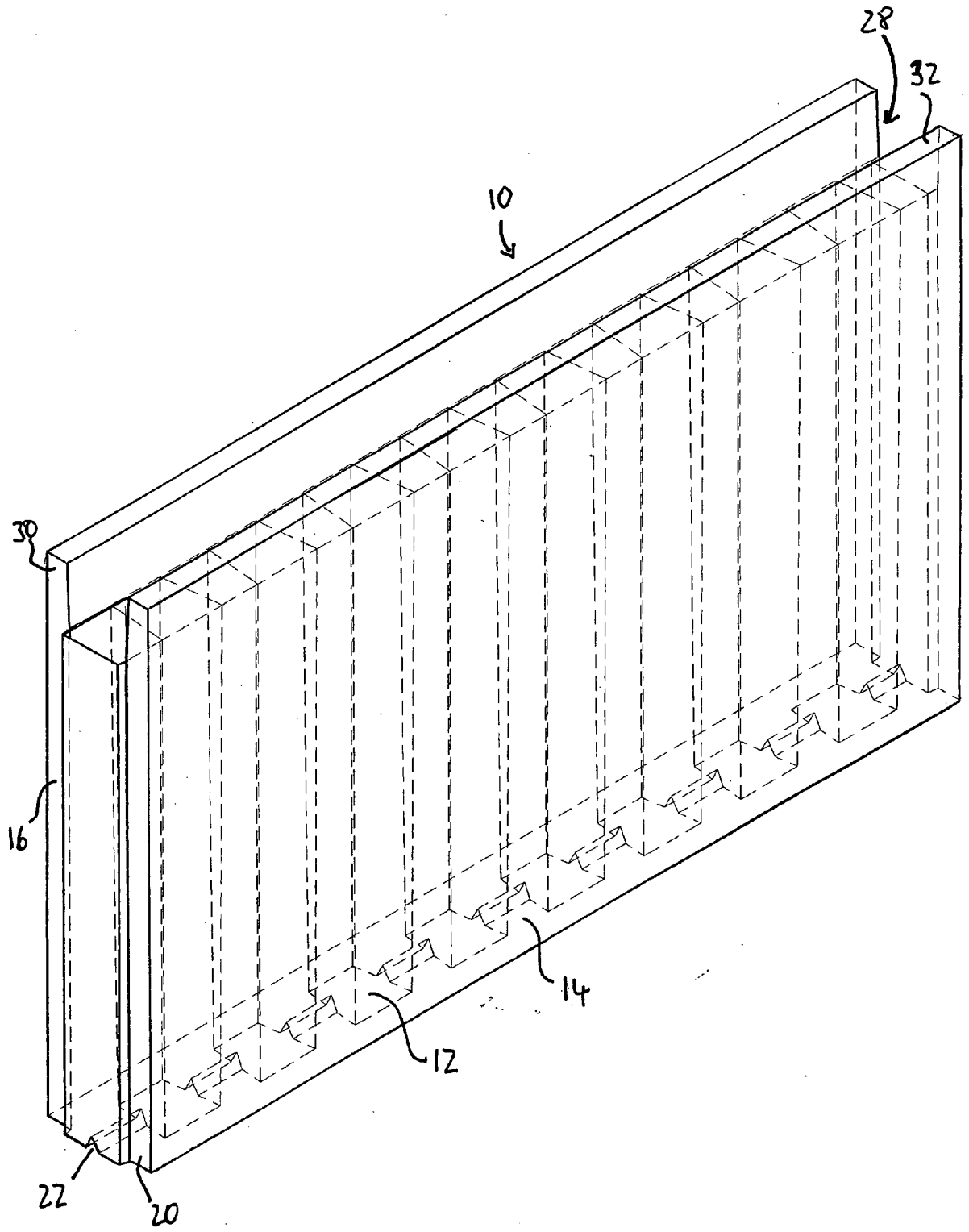
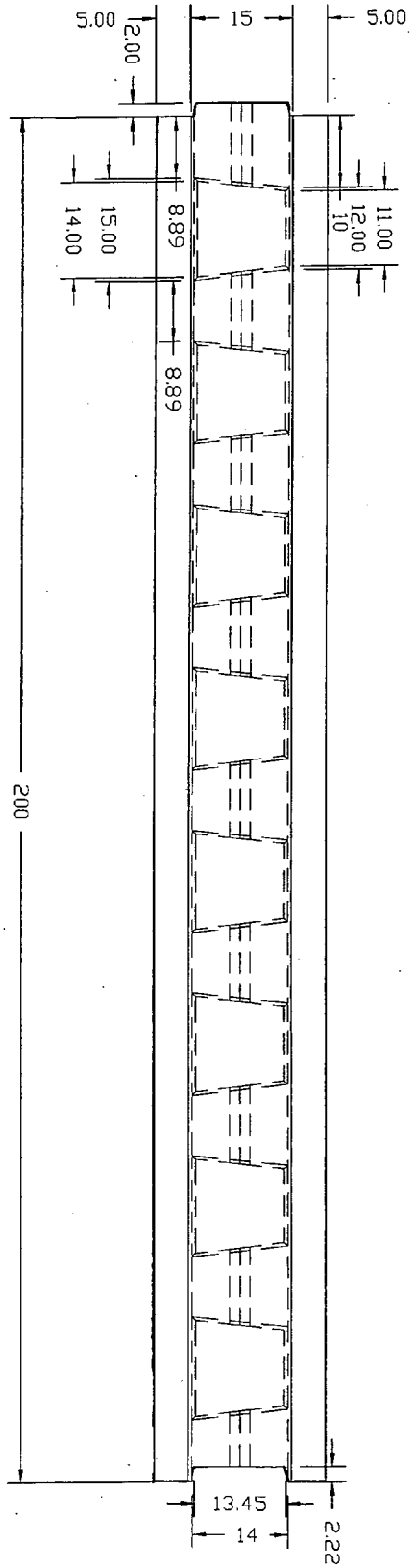


Fig. 1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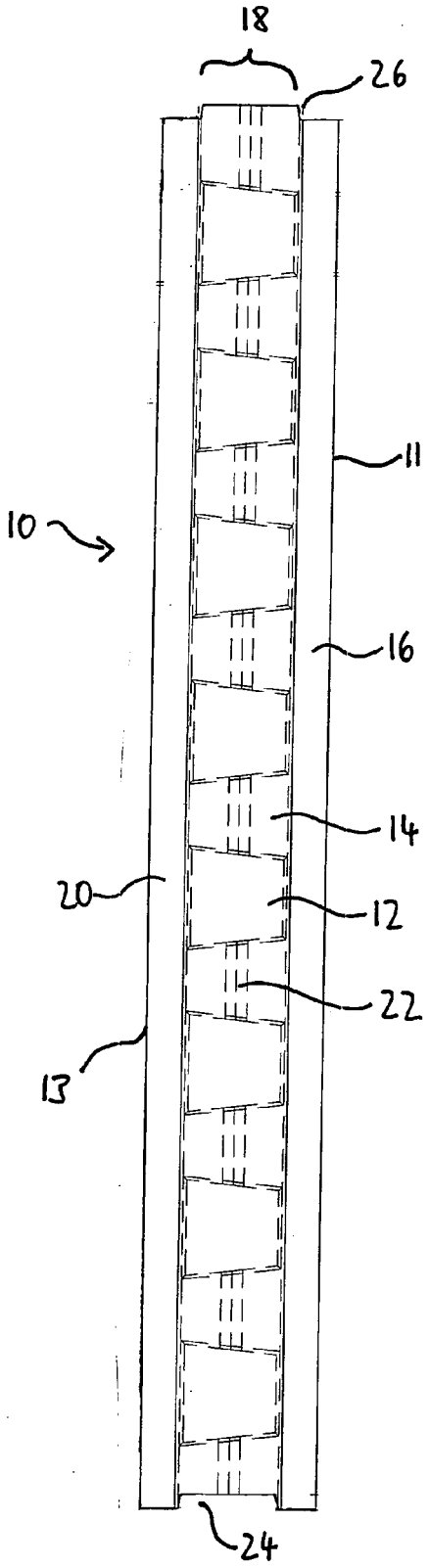
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Fig. 2

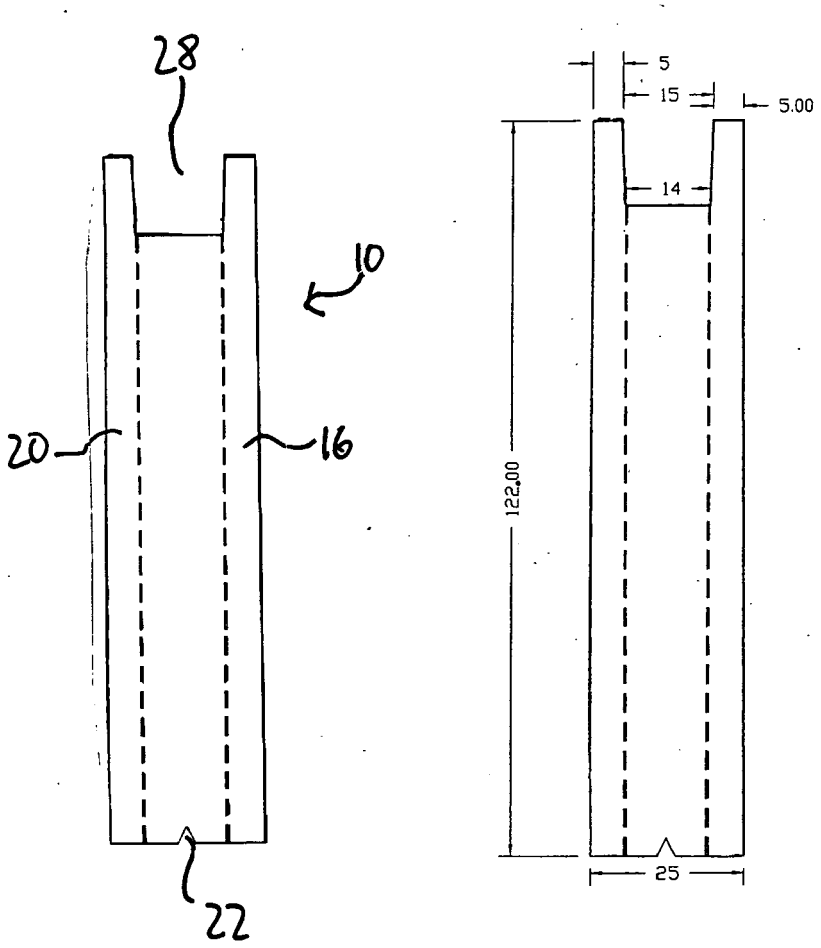

Fig. 3

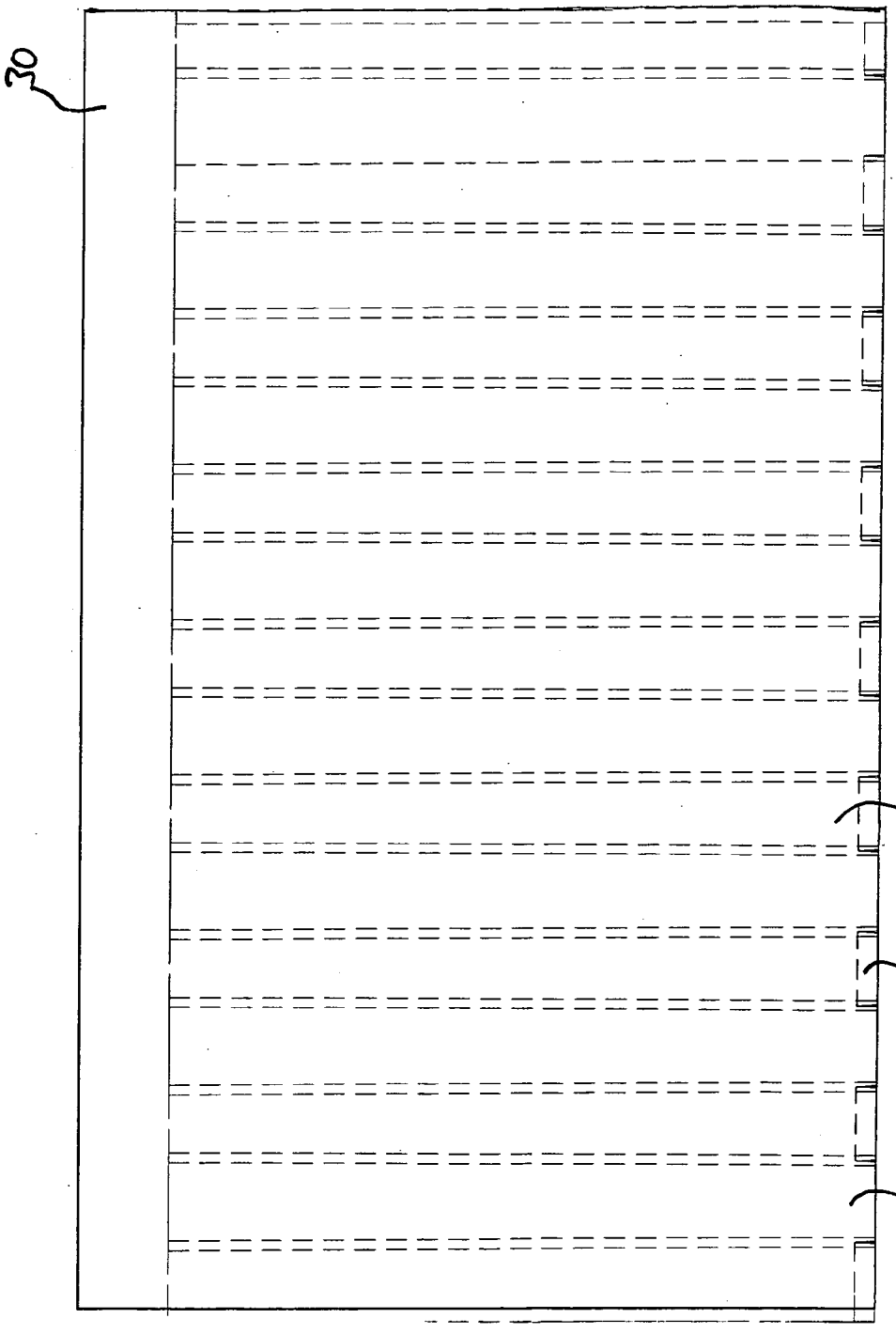

Fig. 4

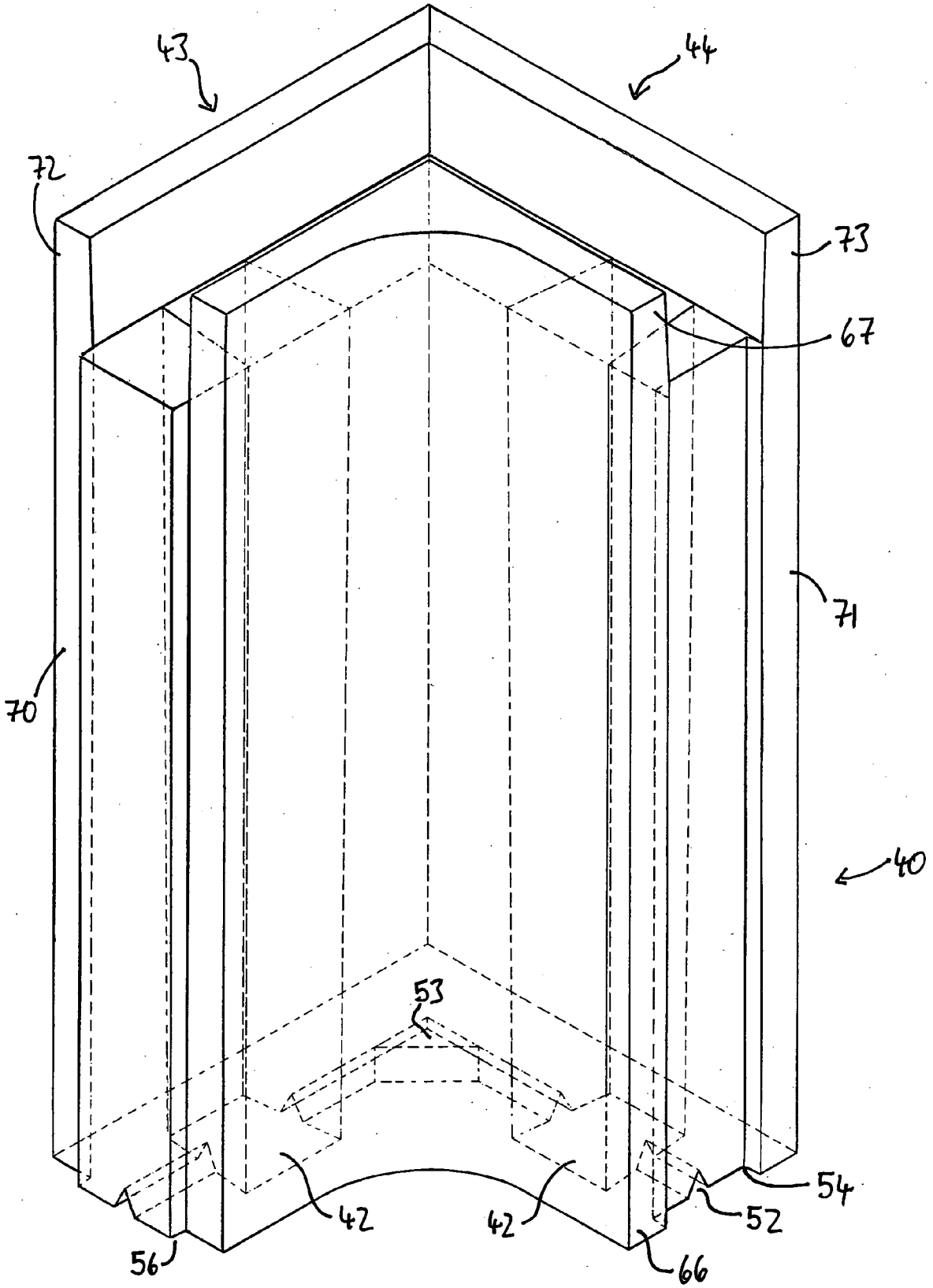

Fig. 5

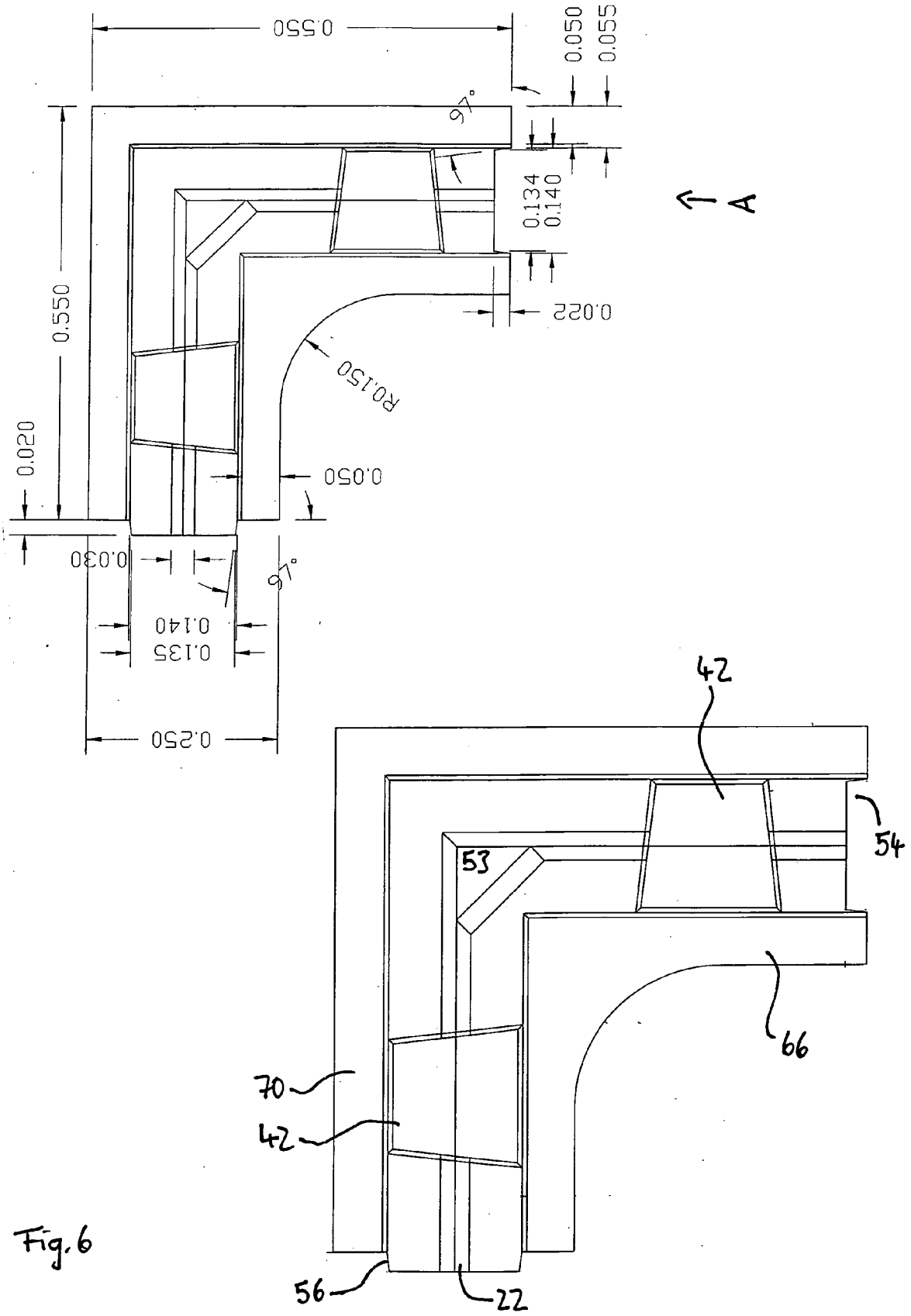
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Fig. 6

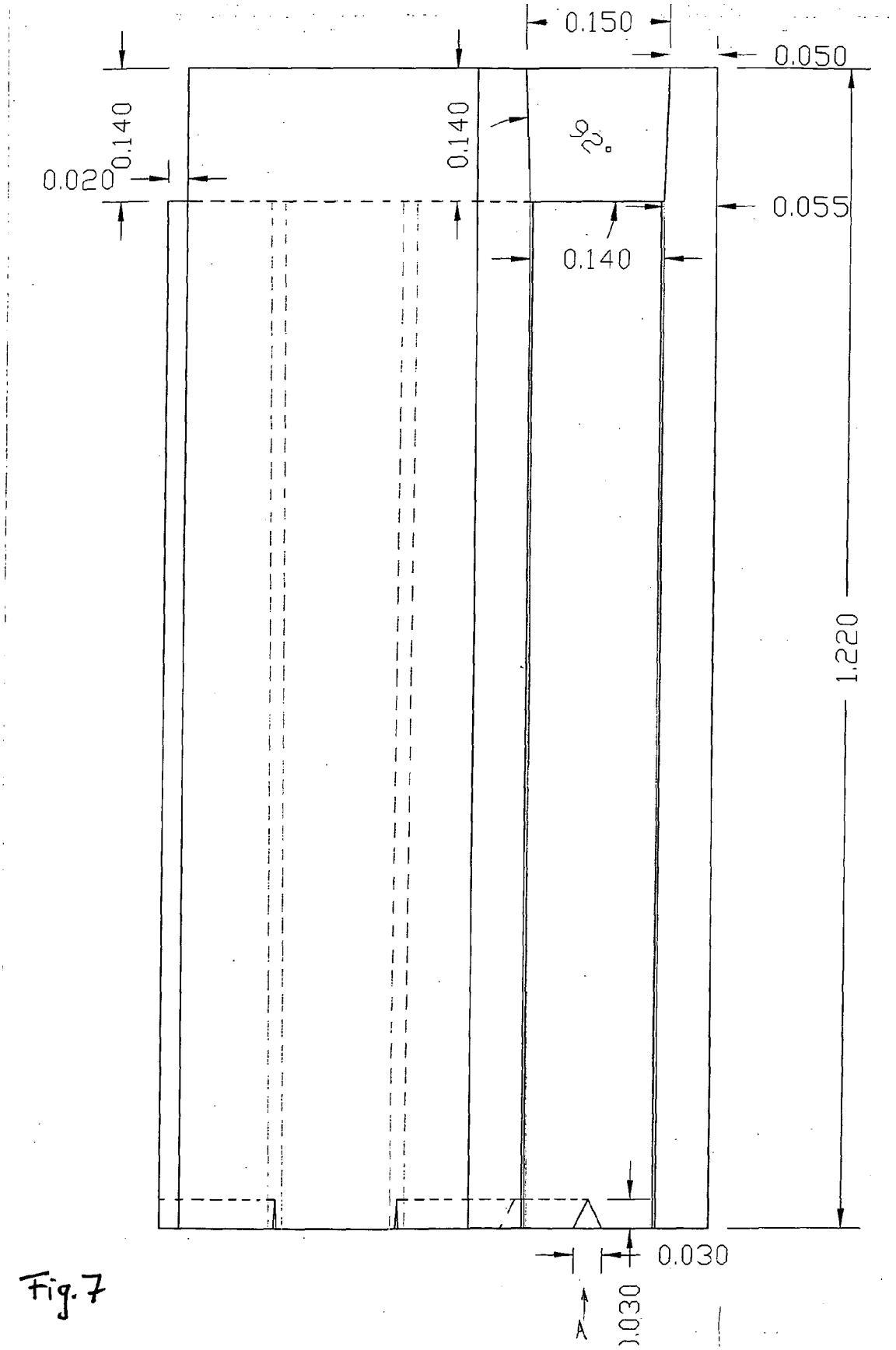

Fig. 7

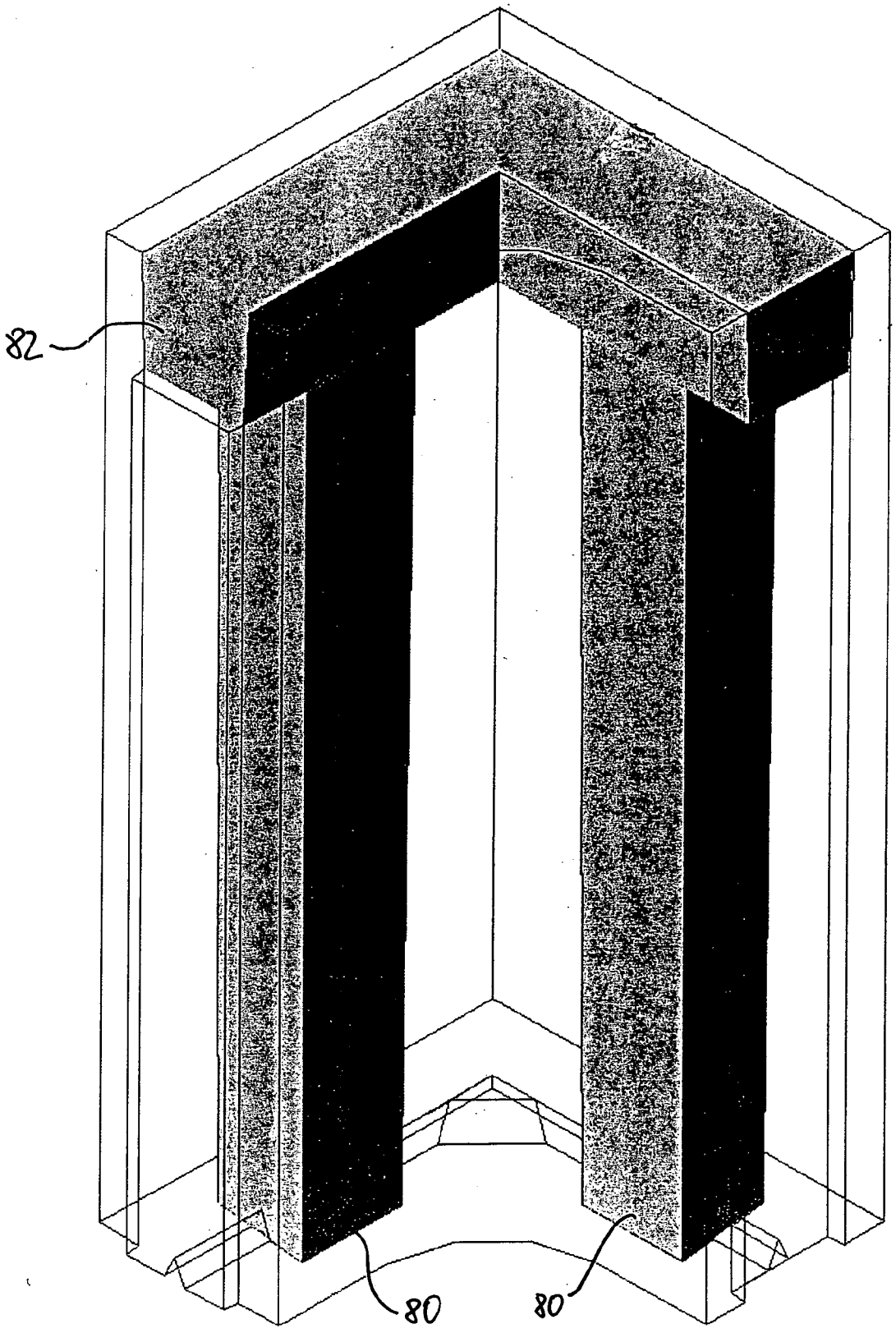

Fig. 8

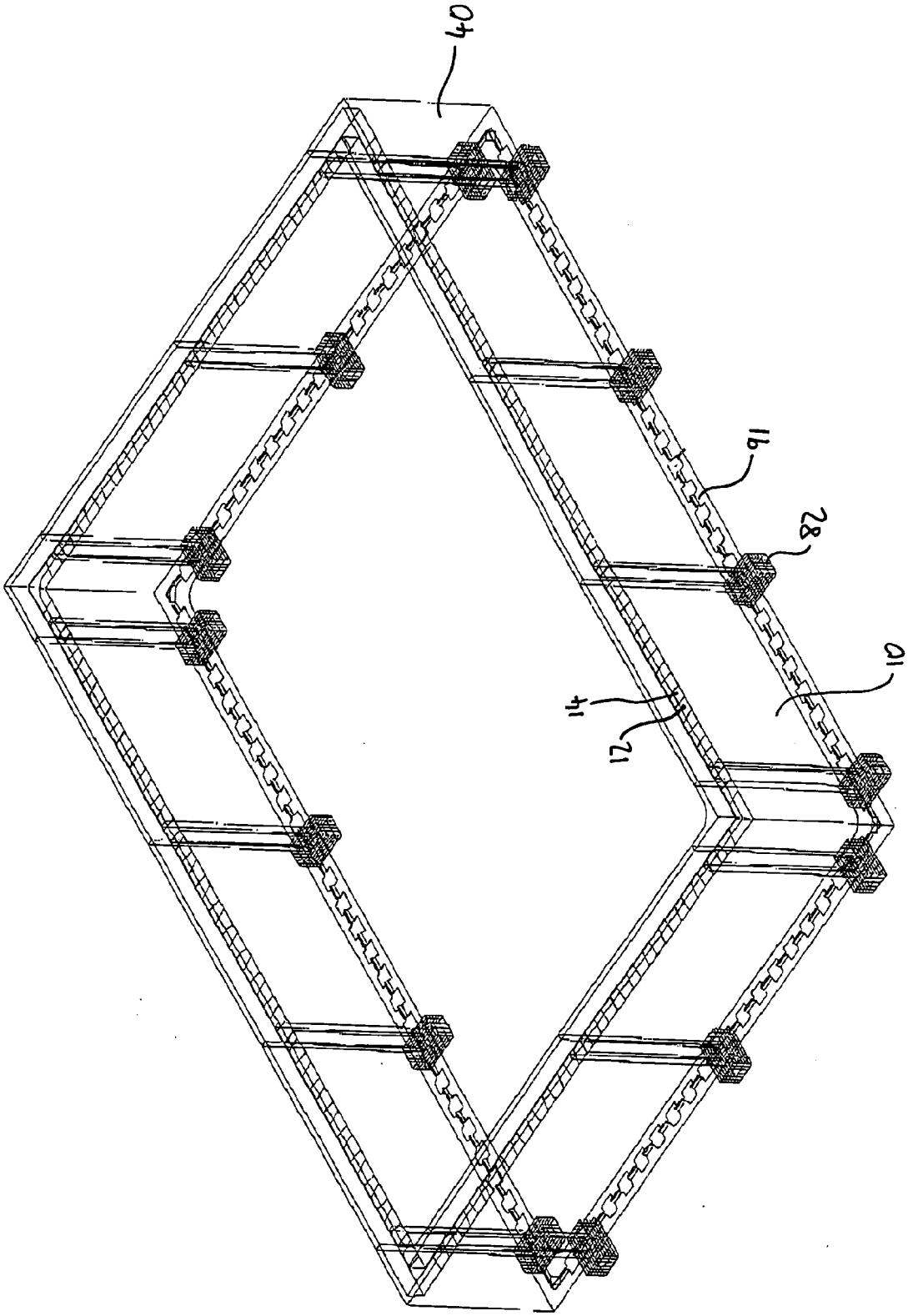

Fig. 6

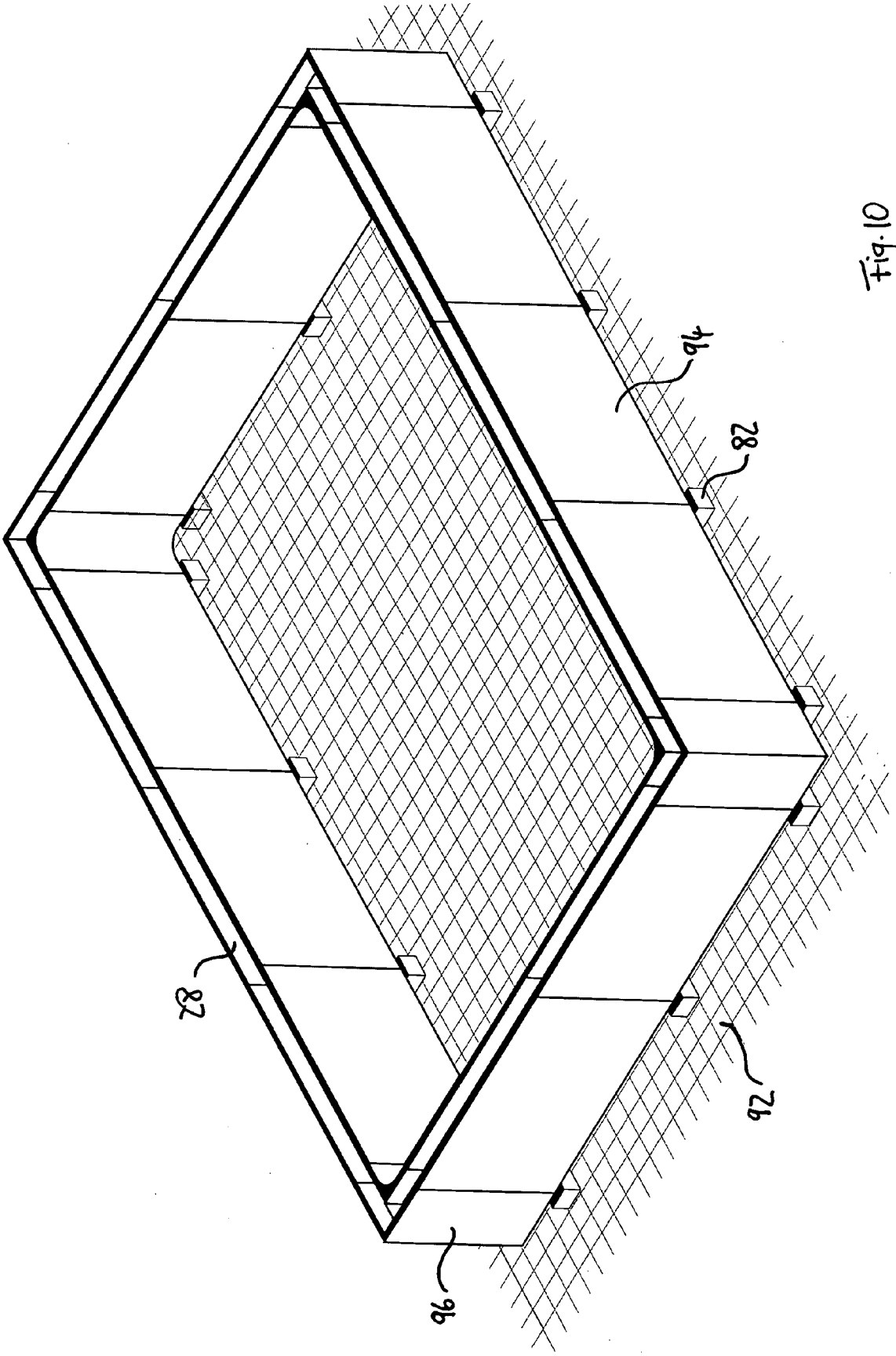

Fig. 10

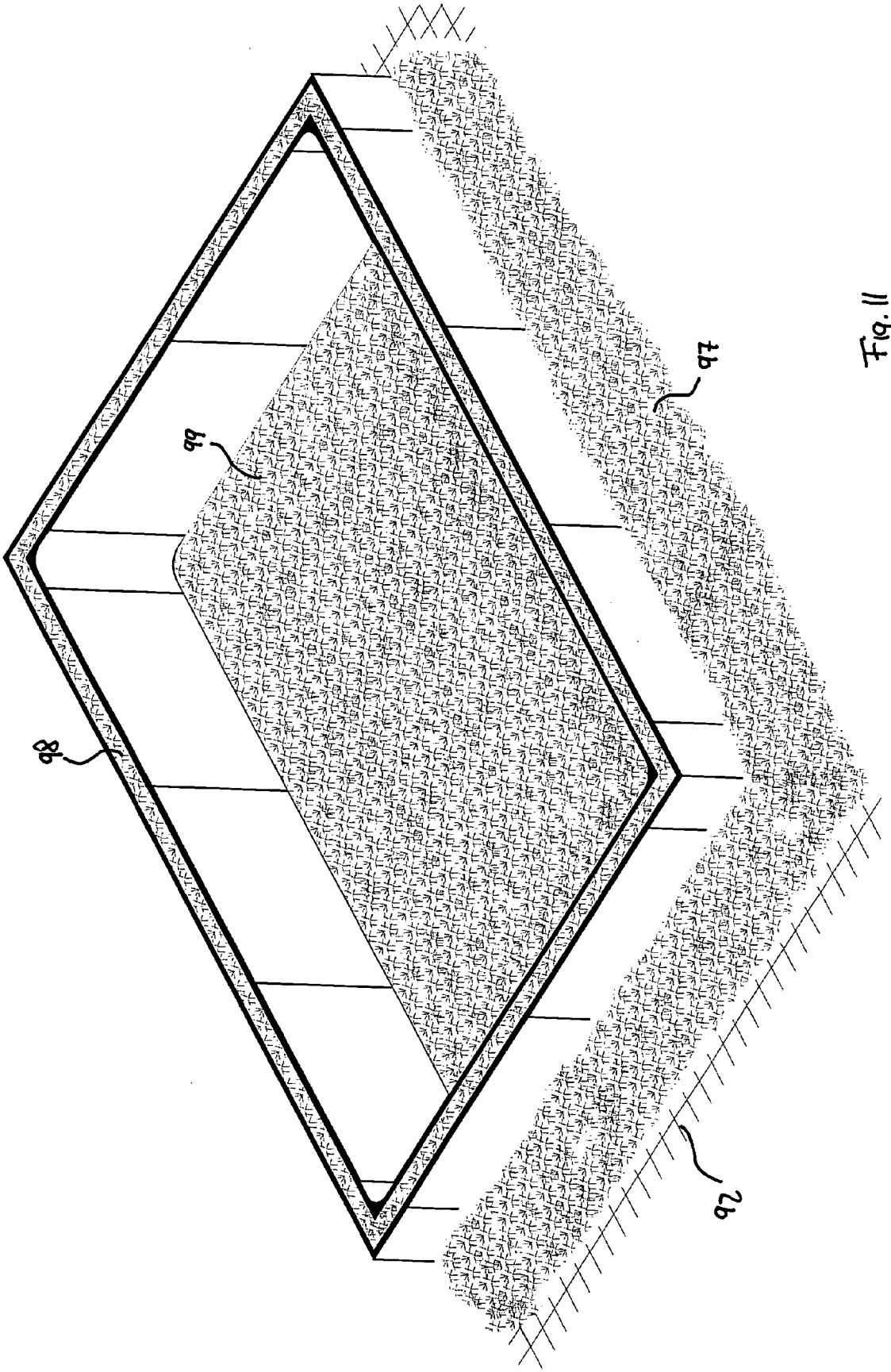

Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
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