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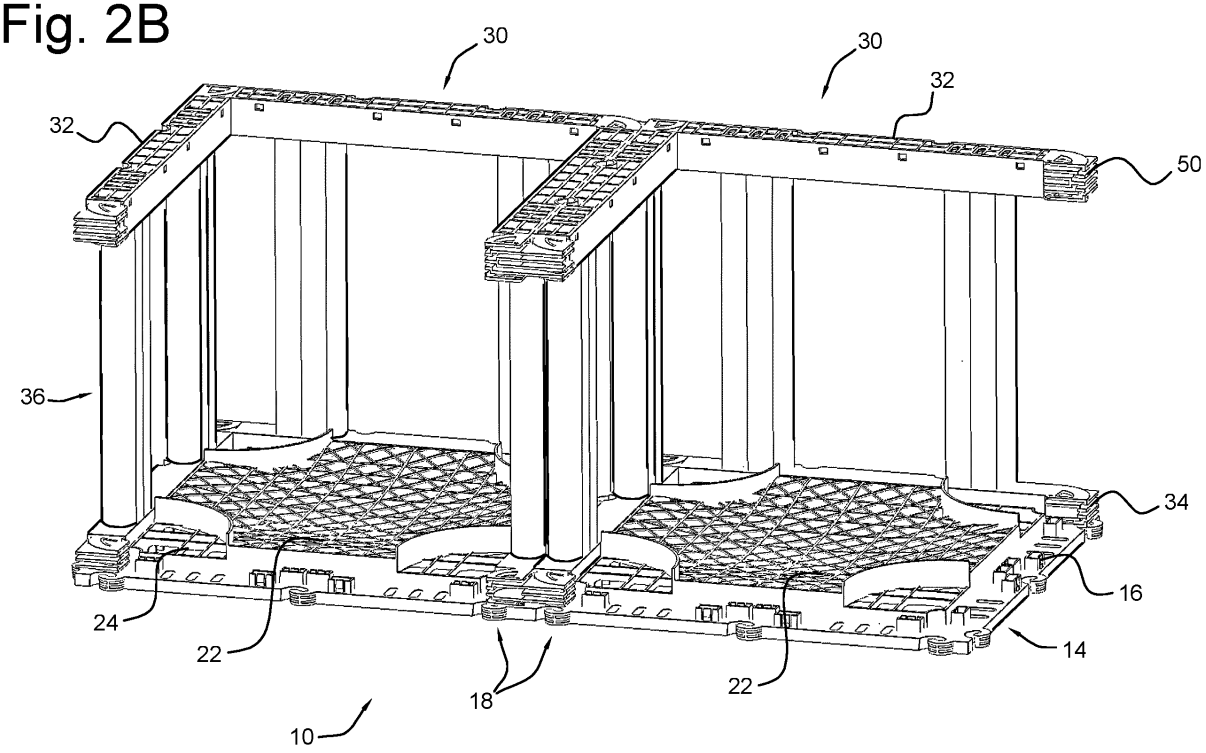
(54) **PANELS FOR DRAINAGE STRUCTURES**

(57) A panel (10) for a drainage box comprises a connection plate (12) comprising an outer perimeter and one or more connection members (14, 16) on the outer perimeter; and a box base (22) elevated with respect to the connection plate (12) and located inside the outer perimeter. The panel can be used as a base or a top for a drainage box or a plurality of drainage boxes.

Fig. 2B



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Description

Field of the invention

[0001] The invention relates to a panel for a drainage structure or a drainage box. Furthermore, the invention relates to a drainage structure comprising such a panel. Additionally, the invention relates to a method for manufacturing such a panel.

Background of the invention

[0002] Liquid receiving, storage and draining structures can be used for various purposes. Often, these structures are placed underground for temporarily storing and draining large amounts of water. The structure provides the possibility to collect and store large amounts of water, such as for instance occur as a result of heavy rain fall and the like.

[0003] The storage capacity thus obtained provides a temporary relief for the surface and underground, in such a way that flooding and erosion can be prevented or at least mitigated. The water collected in the structure may subsequently be released in a controlled manner, whereby a buffer function is obtained. The release may be carried out in several ways, such as discharge through a sewer, by means of infiltration into the underground etc.

[0004] Usually, such structures are built from a plurality of elements that are joined together. The elements typically form a containment structure for receiving the water, having openings towards the surrounding underground, and being surrounded by a textile or foil, such that only liquids may enter the containment structure, and any dirt or other larger elements are kept out.

[0005] The elements used for building up the structure can be modular units which connect to base plates, allowing for flexibility in building to different sizes. They can include columns and panels which fit together to hold the columns together. The panels are typically joined together with clips to secure the panels together and in the proper position. However, the building up of the structure with the panels, columns and clips can be time consuming having to orient everything properly and then ensure they are secured with separate pieces.

[0006] It would therefore be desirable to provide an improved structure for receiving and storing water that alleviated some or all of the above problems.

Summary of the invention

[0007] According to a first aspect, a panel for a drainage box comprises a connection level comprising an outer perimeter and one or more connection members on the outer perimeter; and a box base elevated with respect to the connection level and located inside the outer perimeter. Such a panel can provide a strong and stable base and/or top for a rainwater box or a plurality of rainwater boxes. The connection level with one or more connection members can ensure a strong engagement between the box and panel, and the elevated box base can form inspection and/or cleaning pathways through the box(es).

[0008] According to an embodiment, the panel is rectangular and the connection level extends around the outside perimeter and through a center of long sides of the rectangle. Optionally, the panel comprises two box bases elevated with respect to the connection level and located within the outer perimeter with one box base on each side of the center connection level. Such a configuration can connect to two square boxes, with one around each box base, providing a strong and stable connection between two boxes and a panel.

[0009] According to an embodiment, the one or more connection members comprises one or more cavities and protrusions. Optionally, the one or more connection members comprise cavities to receive feet from a box. Such cavities and/or protrusions provide for stable engagement between the panel and the box, particularly when cavities and protrusions both used.

[0010] According to an embodiment, the box base includes side walls extending above the plane of the box base. Optionally, the side walls extend in a curved manner cutting off corners of the box base. Further optionally, the corners outside the side walls have an elevated base with respect to the connection level, but less than the box base elevation. Such a configuration can provide for a pathway for inspection and/or cleaning formed through boxes, with the corners being elevated enough that they help to arrange the proper connection between boxes and the panel, but not as elevated as the box base to save materials thus resulting in cost and weight savings. If panel is meant for a top of boxes, some embodiments may have a box base which is only slightly elevated as it is not needed to form a pathway.

[0011] According to an embodiment, the panel further comprises one or more side connection elements located at the sides of the connection level. Optionally, each side of the panel comprises at least one side connection element. Further optionally, each side connection element includes a receiving portion and a protruding portion, the receiving portion shaped complementary to the protruding portion such that a panel having a similar connection element can secure to the panel by engaging the respective connection elements such that the protruding portion of the connection element of the panel fits into the receiving portion of the connection element of the second panel, and the receiving portion of the connection element of the panel receives the protruding portion of the connection element of the second panel. The protruding portion and the receiving portion can be at least partially curved, arcuate or semicircular in shape. Such identical connection elements with complementary paired receiving and protruding portions can provide a simple way of connecting panels, freely mounting any connection element to any other connection element. This allows for easy connection, making time-consuming aligning and

orienting superfluous, for example, to mate a male element with a female element. Additionally, this allows for connecting a plurality of panels to form complex and/or lengthy drainage structures more easily and quickly.

[0012] According to an embodiment, the panel comprises a polymer material. Polymer materials can provide for a strong and stable box for an underground storage structure. A polymer material is also relatively easy to use in complex shapes, such as the box with the connection elements.

[0013] According to an embodiment, at least one connection element comprises a locking mechanism to secure a box in place when connected to the connection level around the box base. Such a locking mechanism can ensure the box cannot be removed once engaged to a panel.

[0014] According to an embodiment, the box base is configured to form a planar surface with an upper surface a lower frame of the box and the upper surface of the box base. This can form pathways through multiple boxes, allowing for inspection and/or cleaning devices to easily travel through the structure.

[0015] According to an embodiment, a panel is configured to connect to two boxes. This can provide more stability to the structure having a panel secure to more than one box.

[0016] According to a further aspect, a drainage structure with a top side, a bottom side and side walls extending between the top side and the bottom side is provided. The top side and/or bottom side comprise a plurality of panels.

[0017] According to a further aspect, a method of manufacturing a panel for a drainage box comprises forming a connection level comprising an outer perimeter and one or more connection members on the outer perimeter; and forming a box base elevated with respect to the connection level and located inside the outer perimeter. Optionally, the steps of forming a connection level and forming a box base are performed simultaneously, for example, through injection moulding.

Brief description of the several views of the figures

[0018] The invention will be described further with respect to embodiments shown in the drawings.

Figure 1A shows perspective view of a panel for a drainage structure.

Figure 1B shows a side view of the panel of Figure 1A.

Figure 1C shows a top view of the panel of Figure 1A.

Figure 1D shows a bottom view of the panel of Figure 1A.

Figure 2A shows a perspective view of two boxes being connected to a panel.

Figure 2B shows a view of Fig. 2A with parts of boxes removed for viewing purposes.

Figure 3A shows a view of two aligned panels being connected together side by side.

Figure 3B shows a view of two panels connected together but offset.

Figure 4 shows a schematic view of a drainage structure.

Detailed Description

[0019] Figure 1A shows perspective view of a panel 10 for a drainage structure, Figure 1B shows a side view of the panel 10, Figure 1C shows a top view of the panel 10, and Figure 1D shows a bottom view of the panel 10.

[0020] Panel 10 includes connection level 12 with receiving cavities 14, protrusions 16 and side connection elements 18. Connection level 12 extends around outer perimeter of panel 10 and through a center 20 of the long sides of panel 10. Each short side of panel 10 includes three side connection elements 18, and each long side includes six side connection elements 18, though different embodiments could have different numbers of side connection elements 18.

[0021] Panel 10 also includes box bases 22, which are elevated with respect to connection level 12 and are located on both sides of center 20 of connection level 12. Box base 22 can further include side walls 24, which in the embodiment shown extend in a curved manner around the corners of the box bases 22, leaving box base 22 in a rounded cross or + shape. The corners 26 located outside walls 24 can be elevated with respect to connection level 12, but not as high as box base 22.

[0022] Panel 10 can be formed of a plastic material, or another material which has sufficient strength and durability. For example, panel 10 could be formed as one integral piece through injection moulding or another suitable production method, or could be formed in a number of pieces and joined together.

[0023] Example heights of connection level 12 H_{CL} could be 15 mm; height of corners He could be 30 mm; height of box base H_{BB} could be 50 mm; and height of side walls 24 H_{SW} could be 65 mm.

[0024] As can be seen in Figs. 1C and 1D, panel 10 includes openings from a top to bottom of panel 10 throughout the central box bases 22 and areas inside of the connection level 12. Outer perimeter and center 20 of connection level 12 include few to no openings with the exception of cavities 14 for receiving connecting elements (feet 54) of a box 30, and could either be through holes or blind holes. The openings through panel 10 allow liquid to travel through the panel, and could have a different configuration in other embodiments. Additionally, the surface of box base 22 can include a different configuration, for example, smaller spaced openings in that area as shown in Figs. 1A-1D. This can be useful to ensure any devices travelling on that surface do not become stuck or fall through openings.

[0025] Figure 2A shows a perspective view of two boxes 30 connected to a panel 10, Figure 2B shows a view of Fig. 2A with parts of boxes 30 removed for viewing

purposes, and Figure 2C shows a perspective bottom view of a box 30. In this embodiment, the long sides of panel 10 are twice as long as the short sides allowing for two boxes 30 to be connected, though other embodiments could have a different configuration.

[0026] Each box 30 includes upper frame 32, lower frame 34 and pillars 36, which form first side 40, second side 42, first end 44, second end 46. First side 40 connects to first end 44 and second end 46 at hinges 50 on each of upper frame 32 and lower frame 34. Second side 42 also connects to each of first end 44 and second end 46 at hinges 50 on upper frame 32 and lower frame 34.

[0027] Pillars 36 extend between upper frame 32 and lower frame 34 on each of first and second sides 40, 42 and first and second ends 44, 46. Pillars 36 are shown as three oval shaped columns 37a, 37b, 37c connected to each other, though could have a different configuration, for example a different shape (e.g., cylindrical, prism) and/or number of columns. The connections are typically a planar extension between the columns, which help to increase the strength and prevent buckling.

[0028] Upper frame 32, on its upper surface, includes a cavity 52 aligned with the top of each column 37a, 37b, 37c. A foot 54 extends from the lower surface of lower frame 34 aligned with the bottom of each column 37a, 37b, 37c. Each foot 54 is configured to fit into a cavity 52 of a box 30 or cavity 14 of panel 10 such that boxes 30 can stack on top of one another with feet 54 of the upper box fitting into cavities 52 of the lower box, or that feet 54 secure to cavities 14 in connection level 12 of panel 10. Feet 54 and/or cavities 52/14 can include locking features such that the feet 54 require a large amount of force to be removed from cavities, or even that feet 54 cannot be pulled out of the cavities 52/14 once inserted. Such a locking mechanism could be related to the sizing and/or include other features such as a flange, ridge, shoulder, projection(s), etc.

[0029] Hinges 50 connecting sides 40, 42 and ends 44, 46 are rotatable hinges to rotate the box from a flat or collapsed configuration to a use state (use state is shown in FIGS. 2A-2C). This is shown and described in more detail in NL application number 2029173, titled Foldable Rainwater box, which was filed 10 September 2021, which is hereby incorporated by reference.

[0030] As shown in Figures 2A-2B, box 30 connects to connection level 12, with feet 54 connecting to cavities 14 on panel 10. Protrusions 16 can extend into the underside of lower frame 34, thereby providing stronger engagement between panel 10 and box 30.

[0031] Box 30 surrounds elevated box base 22, and upper surface of lower frame 34 of box 30 aligns with the upper surface of box base 22 to form a continuous surface. Side walls 24 curve around from an inner side of a pillar 36 on one side/end of a box 30 to an inner side of a pillar 36 on an adjacent side/end of the box 30. Thus, when boxes 30 are connected to panel 10, pathways are formed through boxes 30 on the surfaces of box base 22 and lower frame 34. These pathways can be used for cleaning and inspection, allowing cleaning and/or inspection devices to easily travel from one box to another on box bases 22, not having to move over frames, lips, etc. as the upper surface of lower frame 34 and upper surface of box base 22 align to form the pathway. The pathways are typically planar, though can include small variations in height in some embodiments.

[0032] Forming panel 10 to connect to two or more boxes 30 provides more strength and stability to the overall structure. The single panel engaging two or more boxes 30 ensures that there is very little lateral shifting or movement, thereby forming an overall more stable structure. Additionally, panels 10 could be shifted so that they do not fully align throughout a base or top of a structure, further adding stability.

[0033] In some embodiments, panel 10 could be formed larger to accommodate more than two boxes, for example, four boxes 30. Other embodiments could form a panel which was square, and the size of one box.

[0034] Figure 3A shows a view of two panels 10 being connected together side by side through connection elements 18. As shown, each connection element 18 is identical and includes a protruding part 70 and a receiving part 72 which are complementary shaped such that a protruding part 70 fits into a receiving part 72 and vice versa. The connection elements 18 are arranged such that panels can be connected together in an aligned manner such as shown in Fig. 3A or in a shifted manner such as shown in Fig. 3B. The shifted manner can help to add stability to the structure in different directions.

[0035] The panels 10 in Fig. 3A are aligned and connected together on their long sides to secure together in the same plane through six connection elements 18. The panels 10 are connected together, by aligning the connection elements 18 of one panel with the connection elements 18 of the other panel 10 and moving in a direction perpendicular to the plane of the panel 10, causing the connection elements 18 of one panel to slide into the connection elements 18 of the other panel 10.

[0036] The connection elements 18 are secured together such that the protruding portion 70 of one connection element 18 is slid into the receiving portion 72 of the other element and vice versa. This secures the panels 10 together in the same plane such that connecting levels 12 align in the same plane and box bases 22 align in the same plane.

[0037] By using identical connection elements 18 with complementary paired receiving portions 72 and protruding portions 70, the panels 10 can be easily secured together, freely mounting any connection element 18 to any other connection element. This allows for easy connection, making time-consuming aligning and orienting superfluous, for example, to mate a male element with a female element. Additionally, this allows for connecting a plurality of panels 10 to form complex and/or lengthy drainage structures more easily and quickly. By making time-consuming positioning and orientation superfluous due to the identical connection elements 18 which can

secure to any other connection element, the panels 10 can be easily and simply secured together.

[0038] While panels 10 have been shown and described as base panels, they could also form top panels for an array of boxes 80 such as that shown in Fig. 4. Panels 10 could form a base and/or top of such a structure, with the elevated (box base) portions and connecting cavities and protrusions ensuring that boxes 30 and panels 10 stay securely engaged whether the panel 10 is on top of or beneath the box. When on bottom, box bases 22 form an inspection and/or cleaning pathway throughout the structure no matter how large. In some embodiments, panels could even be used at intermediate levels, for example, every two or three stacks of boxes, and could provide a stabilizing influence as well as an additional inspection path at those positions.

[0039] In summary, panel 10 with a connection level and an elevated box base form a strong base and/or top for a rainwater box and/or modular array of rainwater boxes connected together. The connection level with connection members provides a stable and strong engagement of one or more boxes, and elevated box base forms pathways from one box to another allowing inspection and/or cleaning devices to easily travel through the boxes and/or array. Forming the panel 10 to accommodate two or more boxes can provide additional strength and stability to a rainwater storage structure and enable a more efficient assembly on-site, having to connect fewer base and/or top plates. Such a configuration with the side connectors 18 also allow for connecting at any orientation and even offsetting one panel to the next, providing strength and stability in more directions.

[0040] While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed, but that the invention will include all embodiments falling within the scope of the appended claims.

Claims

1. A panel (10) for engaging with a drainage box (30), the panel comprising:

   a connection level (12) forming an outer perimeter of the panel and comprising a first surface and a second surface opposite to the first surface and one or more connection members (14,16) located on the first surface ; and
   a box base (22) elevated with respect to the first surface of the connection level (12) and surrounded by the connection level;
   wherein the box base (22) includes side walls (24) extending above the plane of the box base (22), the side walls extending in a curved manner cutting off corners (26) of the box base (22).

2. The panel of claim 1, wherein the panel is rectangular and the connection level (12) further extends through a center (20) of long sides of the rectangle.

3. The panel of claim 2, wherein the panel comprises two box bases (22) elevated with respect to the connection level and surrounded by the connection level with one box base on each side of the center connection level.

4. The panel of any of the preceding claims, wherein the one or more connection members comprises one or more cavities (14) and protrusions (16).

5. The panel of claim 4, wherein the one or more connection members comprise cavities (14) able to receive feet from the drainage box.

6. The panel of any of the preceding claims, wherein the box base (22) includes side walls (24) extending above the plane of the box base (22).

7. The panel of any of the preceding claims, and further comprising one or more side connection elements (18) located at a third surface connecting the first and second surfaces of the connection level, preferably wherein each side of the panel comprises at least one side connection element (18).

8. The panel of claim 7, wherein each side connection element (18) includes a receiving portion and a protruding portion, the receiving portion shaped complementary to the protruding portion such that a panel having a similar connection element can secure to the panel by engaging the respective connection elements such that the protruding portion of the connection element of the panel fits into the receiving portion of the connection element of the second panel, and the receiving portion of the connection element of the panel receives the protruding portion of the connection element of the second panel, preferably wherein the protruding portion and the receiving portion are at least partially curved, arcuate or semicircular in shape.

9. The panel of any of the preceding claims, comprising a polymer material.

10. The panel of any of the preceding claims, wherein the at least one connection element comprises a locking mechanism to secure a box in place when connected to the connection level around the box

base (22), preferably wherein the box base (22) is configured to form a planar surface with an upper surface, a lower frame of the box and the upper surface of the box base.

11. The panel of any of the preceding claims, wherein the panel is configured to connect to two drainage boxes.

12. A drainage structure with a top side, a bottom side and side walls extending between the top side and the bottom side, wherein the top side and/or bottom side comprise a plurality of panels according to any of the preceding claims.

13. A method of manufacturing a panel (10) for engaging with a drainage box (30), the method comprising:

forming a connection level (12) forming an outer perimeter of the panel and comprising a first surface and a second surface opposite to the first surface and one or more connection members (14,16) located on the first surface; and
forming a box base (22) elevated with respect to the first surface of the connection level and surrounded by the connection level,
wherein the box base (22) includes side walls (24) extending above the plane of the box base (22), the side walls extending in a curved manner cutting off corners (26) of the box base (22).

14. The method of claim 13, wherein the steps of forming a connection level and forming a box base are performed simultaneously.

15. The method of any of claims 13-14, wherein the panel is formed through injection moulding.

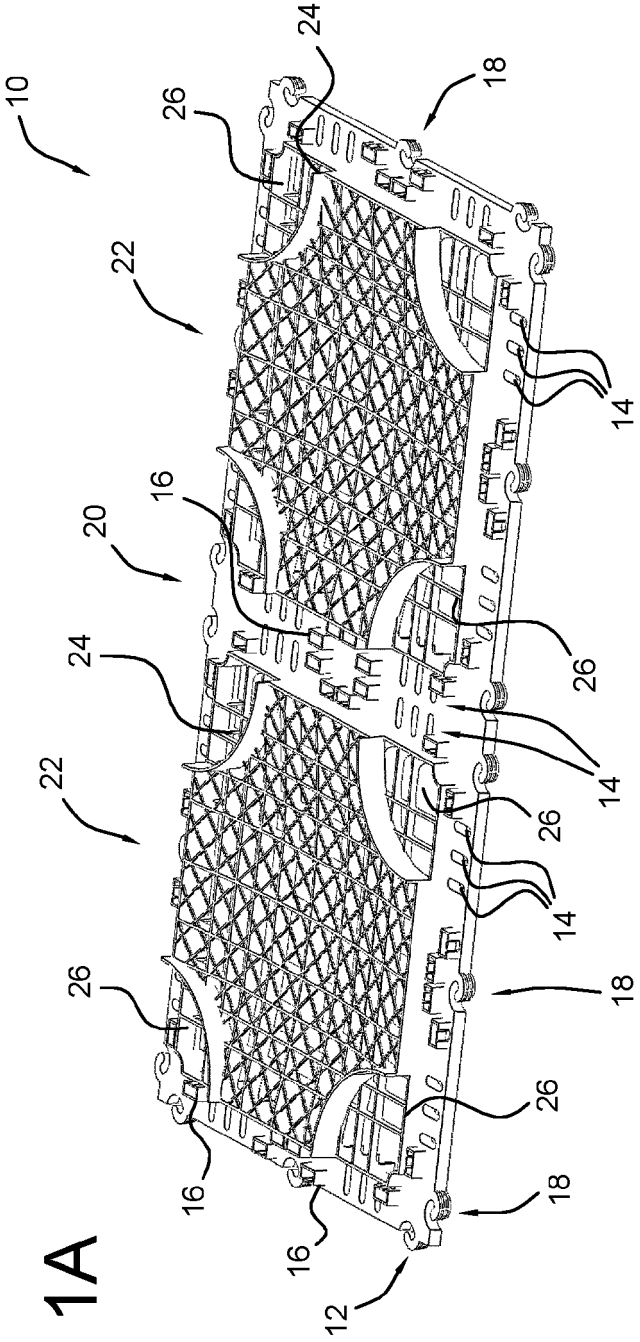


Fig. 1A

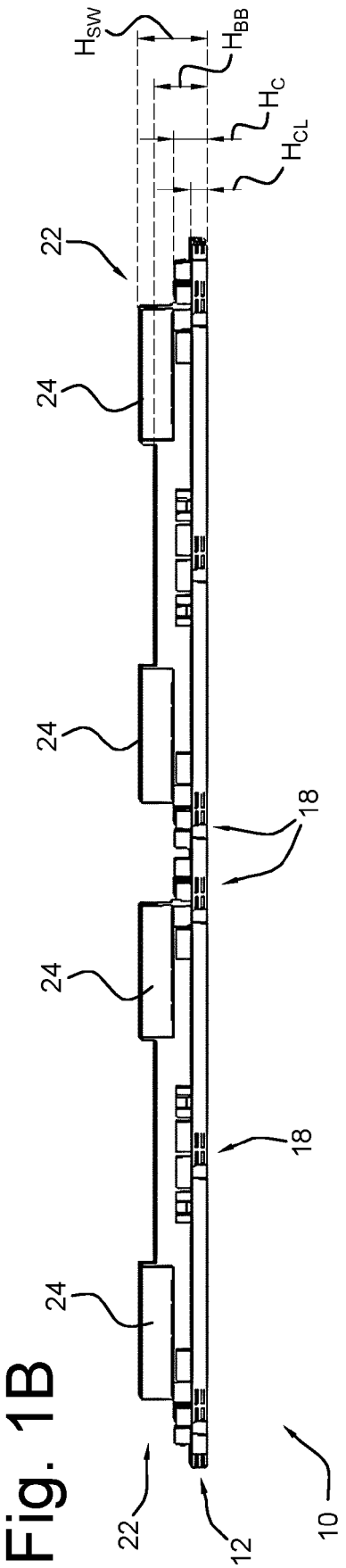


Fig. 1B

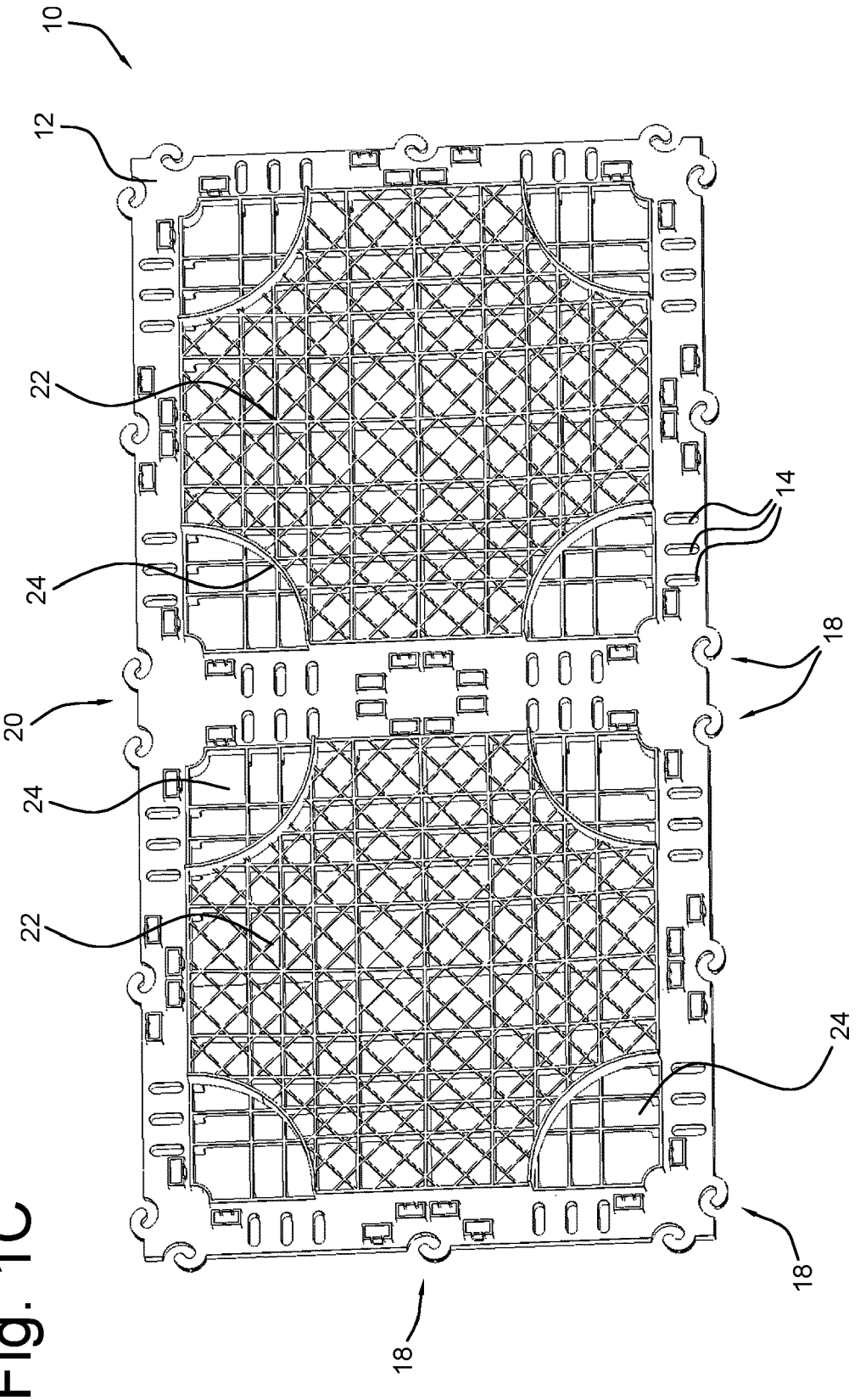


Fig. 1C

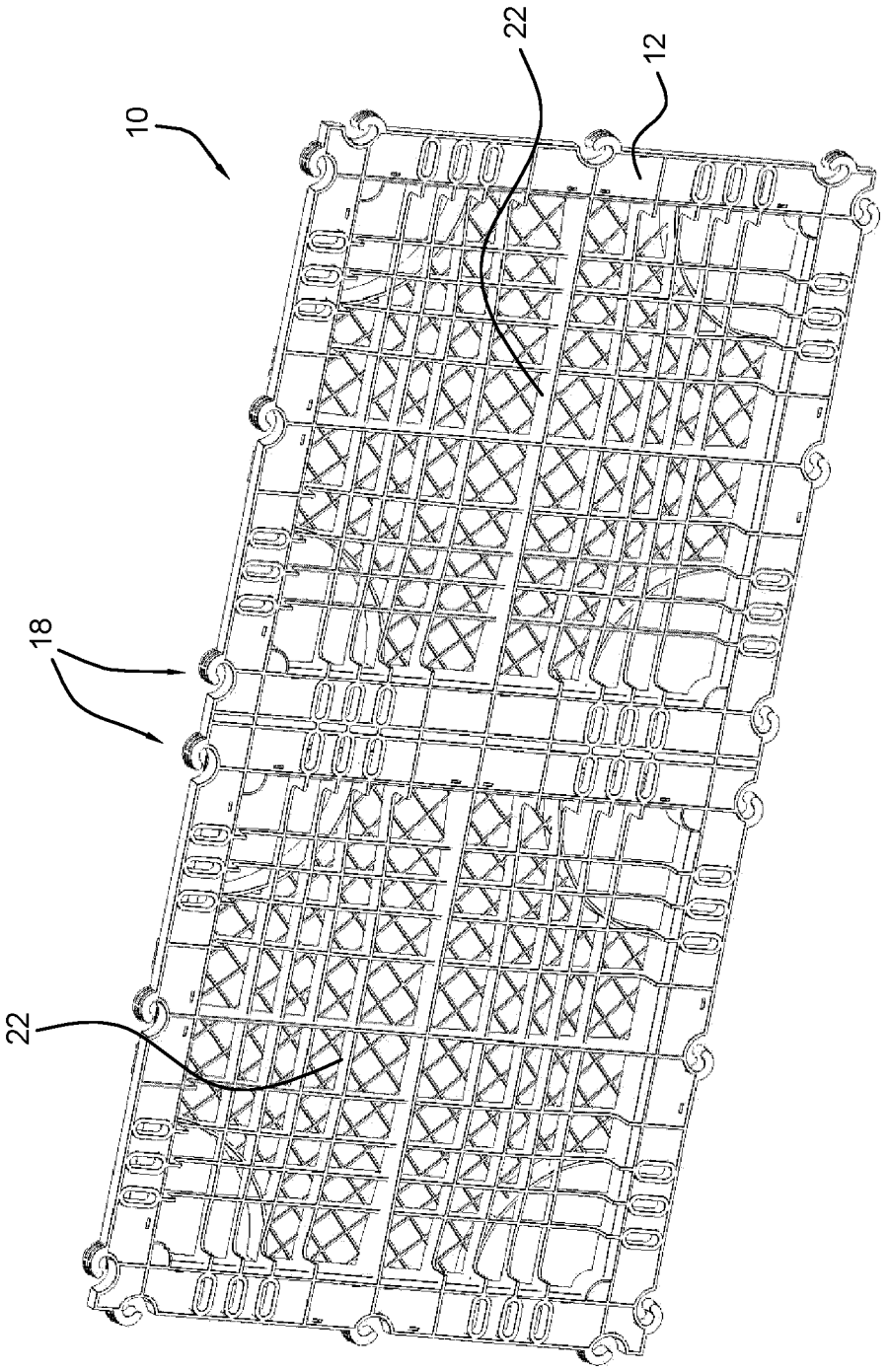


Fig. 1D

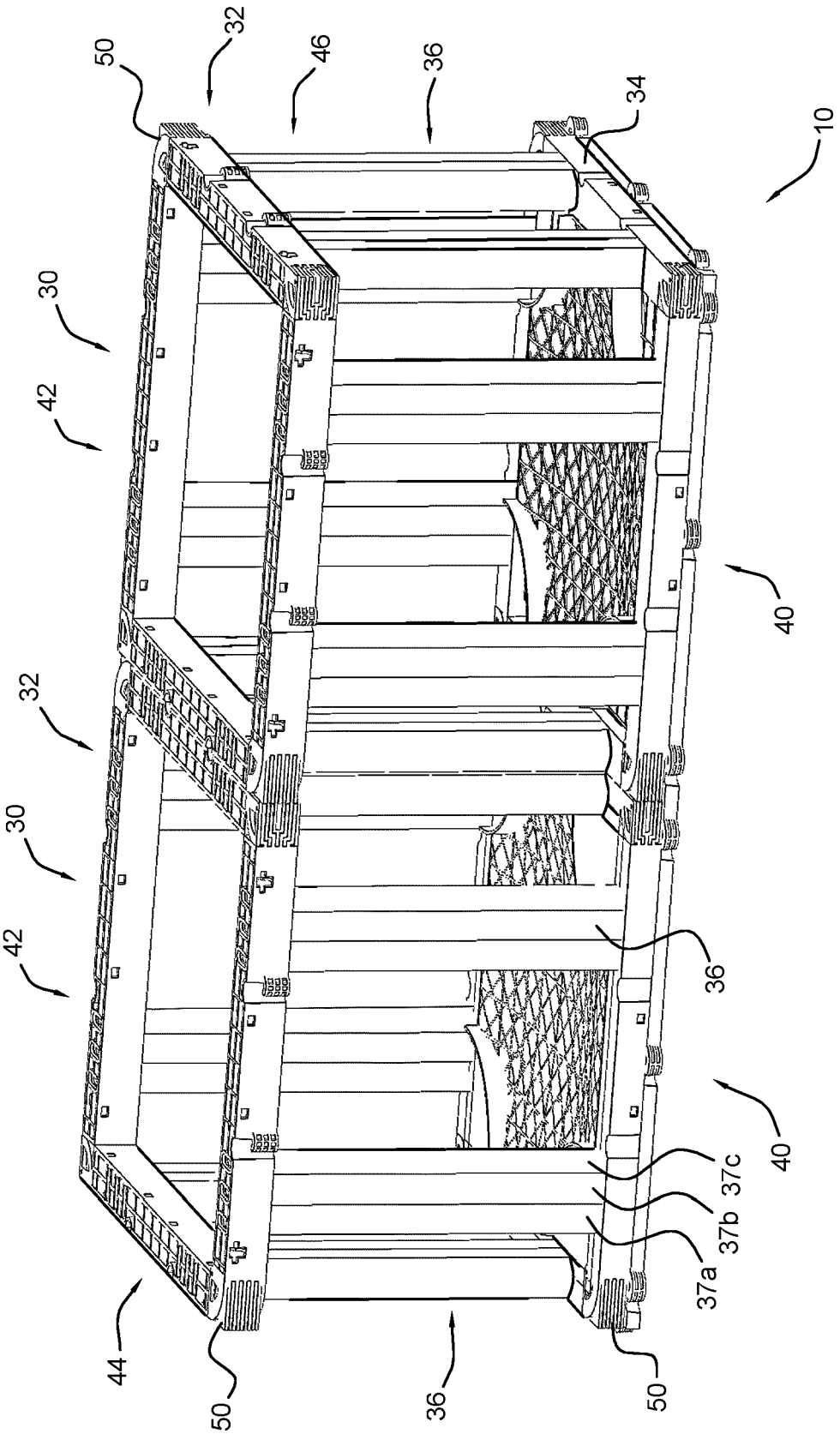


Fig. 2A

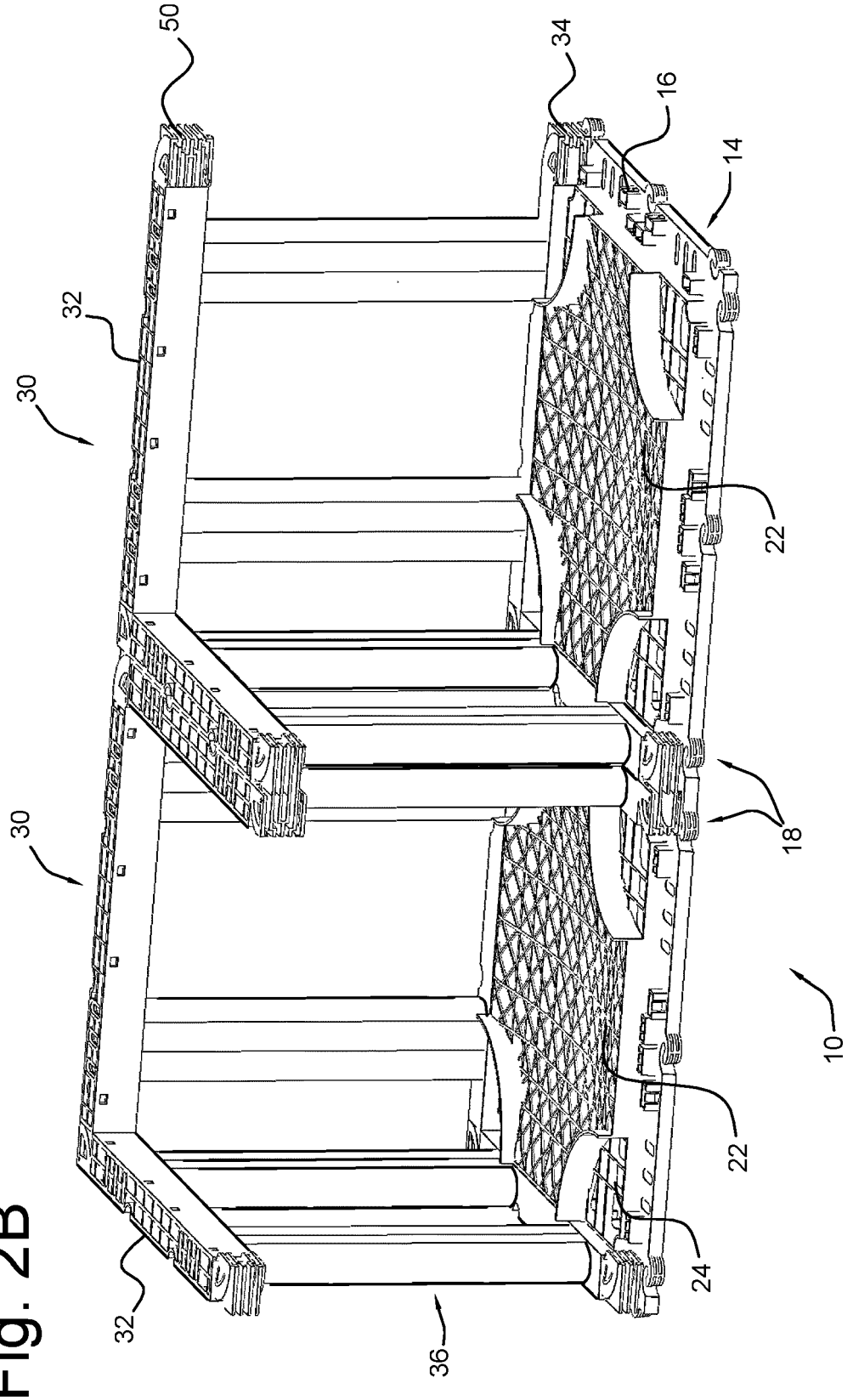


Fig. 2B

Fig. 2C

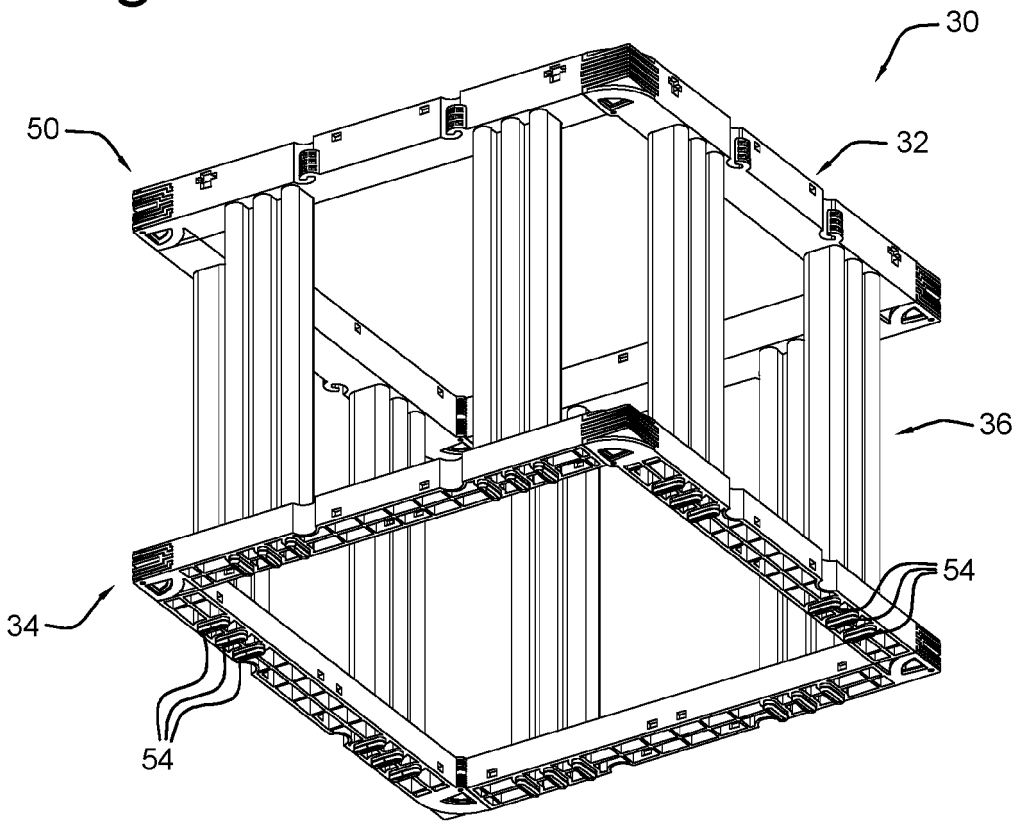


Fig. 3A

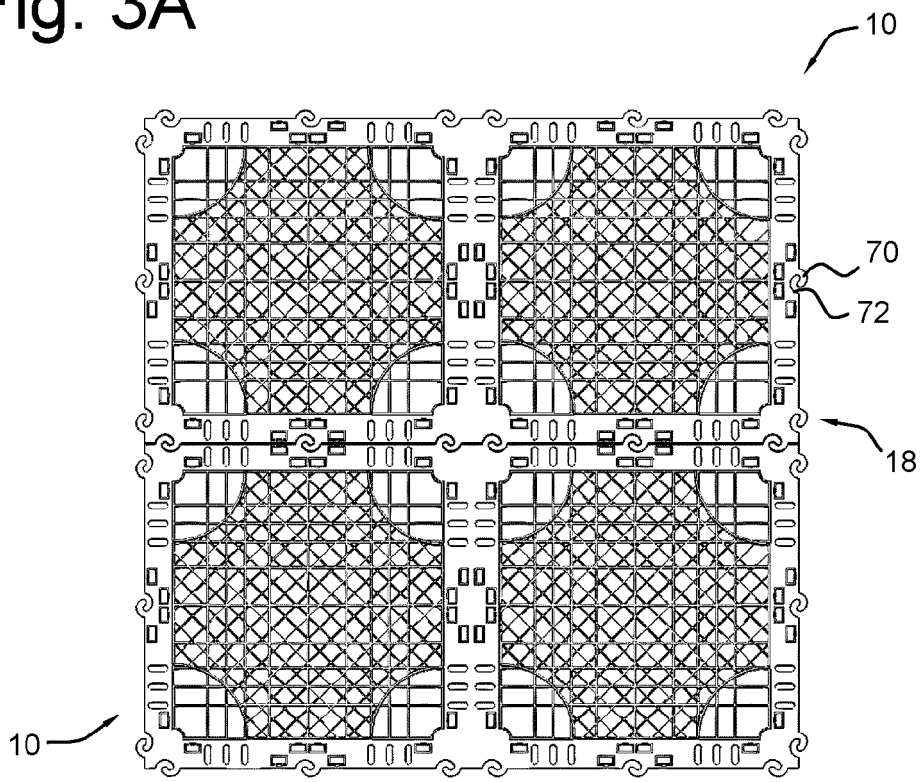


Fig. 3B

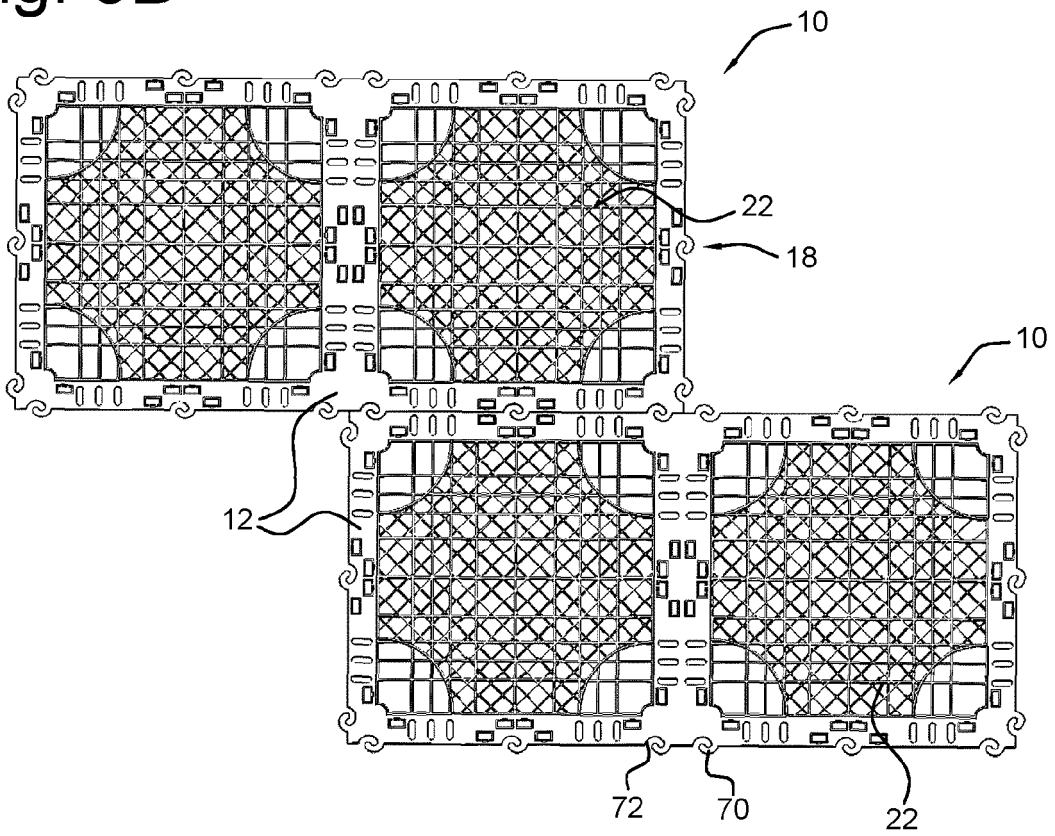
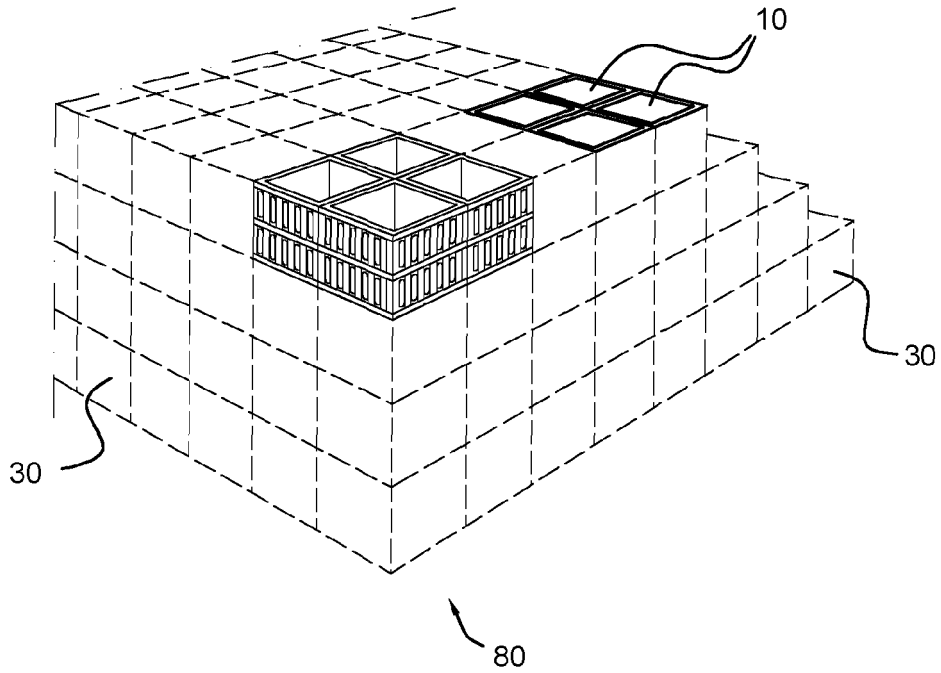


Fig. 4



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EUROPEAN SEARCH REPORT

Application Number
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E03F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 July 2023	Horst, Werner

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 16 7806

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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REFERENCES CITED IN THE DESCRIPTION

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