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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 January 2008 (24.01.2008)

PCT

(10) International Publication Number
WO 2008/009879 A1

(51) International Patent Classification:
E01C 5/00 (2006.01)

(21) International Application Number:
PCT/GB2007/002329

(22) International Filing Date: 22 June 2007 (22.06.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0614158.4 17 July 2006 (17.07.2006) GB

(71) Applicant *(for all designated States except US)*: **PLASTICORE LIMITED** [GB/GB]; Collins Farm, Priors Hardwick Road, Upper Boddington, Daventry, Northamptonshire NN11 6DW (GB).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **DYER, Timothy, J.** [GB/GB]; Collins Farm, Priors Hardwick Road, Upper Boddington, Daventry, Northamptonshire NN11 6DN (GB). **WEIR, John, M.** [GB/GB]; Haute Future Limited, Farndon Hill Barn, Byfield, Northamptonshire NN11 6UQ (GB). **THOMAS, Craig** [GB/GB]; 34A Townsend Lane, Upper Boddington, Daventry, Northamptonshire NN11 6DR (GB).

(74) Agents: **GRAY, James** et al.; Withers & Rogers LLP, Goldings House, 2 Hays Lane, London SE1 2HW (GB).

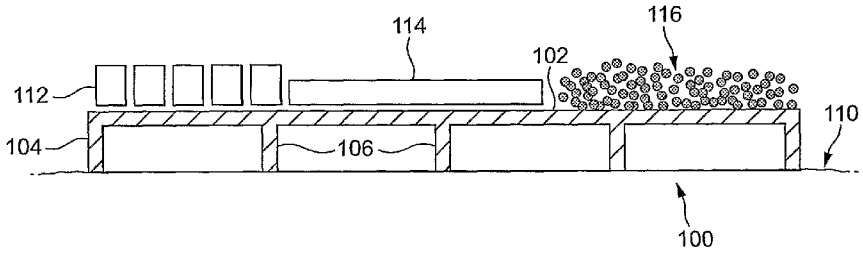
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN,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

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** SUPPORT MEMBER OR REINFORCEMENT FOR USE IN EARTHWORKS



(57) **Abstract:** A rigid plastics tray (100) has a planar base (102), an outer periphery (104) and internal walls (106) that form compartments on the base. The tray is used in the substructure of pavements and the like, e.g. in lieu of hardcore or other sub-base material. In use, the tray can be placed on a ground surface with its base uppermost, wherein an upper layer of paving (112,114,116) can be supported by the tray. The tray can also be used with its base lowermost, wherein the tray is used to contain fill material, typically below ground level, e.g. for use as a soakaway. The tray may include drainage apertures in its base and service apertures in the internal walls for passing service cables and conduits through the tray.

WO 2008/009879 A1

Support member or reinforcement for use in earthworks

This invention relates to a support member or reinforcement for use in earthworks, more particularly, but not exclusively, to a support member in the form of a plastics tray for use in the substructure of pavements and the like.

The preparation of traditional pavement structures such as roads, pathways and car parks typically requires a large volume of in situ earth material to be removed and replaced with a specifically compacted sub-base material, so as to form a suitable substructure onto which an upper pavement layer can be applied.

There is often a significant cost, both financial and environmental, associated with quarrying and transporting raw sub-base materials to an infill site, as well in the disposal of the removed spoil.

It is an object of the invention to provide a ground support or reinforcement which can reduce the volume of material required to create the substructure of pavements and the like, particularly on a domestic level, such as for use in domestic garden, driveway and patio improvements.

According to one aspect of the invention, there is provided a ground support member for use in earthworks comprising a grid-like matrix upstanding from a planar base.

According to another aspect of the invention, there is provided a ground support member for use in supporting a paved surface or the like, the ground support member comprising a plastics tray having a rigid planar base and a rigid matrix upstanding from said base so as to define individual compartments on said base.

It will be understood that the terms 'paved surface', 'pavement' or 'paving' when used herein are not limited to surfaces created using paving stones or slabs.

The invention is primarily intended to serve as a reinforcement in subsurface applications such as when constructing paved areas and tennis courts. The ground support member is

effective in replacing or reducing the need for excavation and/or the use of conventional sub-base materials. Indeed, the invention is suitable for use as a direct replacement for hardcore.

In preferred embodiments, the tray is primarily intended for use in carrying dead and live loads. That is to say, the support member is not simply a tile or flooring which is designed to act as a surface finish to carry live loads, such as pedestrians. The tray of preferred embodiments is particularly designed for use as a subsurface element onto or over which a surface finish of paving or the like is to be applied.

The tray can be used with the base uppermost or lowermost, depending on local ground conditions, for example. In poor ground, it may be preferred to locate the base lowermost, so that the base can act to spread any load applied to the support member from above. However, it is preferred if the support member is used with its base uppermost, whereby an upper surface layer of paving or the like is applied onto the base.

The tray is particularly advantageous in that it can provide support for an upper layer over voids or consolidation that might occur in the immediate subsurface material, and which that might otherwise lead to sag or rutting in the upper layer if the support member were not used as an intermediate reinforcement. The base, in particular, will typically span across and be self supporting over any such voids or consolidation to prevent sag in the upper layer.

There is also provided a method of paving comprising the steps of locating at a subsurface location a plastics tray having a rigid planar base and a rigid matrix upstanding from said base so as to define individual compartments on said base, and laying an upper pavement surface over said tray, wherein the tray is located with its base uppermost or lowermost, depending on the nature of the application.

According to another aspect of the invention, there is provided a plastics tray for use in ground works, the tray having a rigid planar base and a rigid matrix upstanding from said base so as to define individual compartments on said base.

The trays referred to above are of particular use for domestic patio and driveway applications, wherein one or more can be laid together on a ground surface, preferably using pegs, piles or a frame structure which supports the corners and/or the whole or part of the periphery of each

tray, with the base of each tray arranged uppermost, so that conventional paving can be applied as an upper surface layer onto said bases.

The trays are also suited for use in lieu of hardcore, for example in the construction of a car park, wherein a large area can be roughly dug out to predetermined level and covered using an array of said trays and a continuous surface formed over said trays.

According to a further aspect of the invention, there is provided a method of modifying an area of ground, including the steps of providing a plastics tray at a desired ground location, the tray having a rigid planar base and a rigid matrix upstanding from said base so as to define individual compartments on said base, and infilling the compartments with fill material.

The trays preferably include drainage apertures, so as to be suitable for use as a soakaway.

In other embodiments, the trays can be used as removable covers, for example as a cover for an underground service chamber.

In embodiments wherein the depth of the matrix is less than 300 mm, the base can be made suitably flexible to allow the invention to be supplied in roll form, as opposed to other embodiments in which tray may take the form of a strictly rigid plate-like element, which can be supplied individually or in a stack.

Other aspects, features and advantages of the invention will be readily apparent from the claims and the following description of preferred embodiments of the invention, made, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a ground support member;

Figure 2 is a schematic cross-sectional view of the support member of Figure 1 in use in a first application;

Figure 3 is a schematic cross-sectional view of the support member of Figure 1 in use in a second application;

Figure 4 is a schematic cross-sectional view of the support member of Figure 1 in use on poor ground;

Figure 5 is a schematic perspective view of a modified ground support member;

Figure 6 is a schematic cross-sectional view of the support member of Figure 5 interconnected with other support members;

Figure 7 is a schematic perspective view of a further modified ground support member;

Figure 8 is a schematic perspective view of a still further modified ground support member;

Figure 9 shows stoppers being used to plug apertures in the support member of Figure 8; and

Figure 10 is a schematic cross-sectional view through the support member of Figure 8, incorporating a cover plate.

A ground support in the form of a tray 100 is shown in Figure 1. The tray 100 is preferably made from a rigid plastics material and is specifically intended for use in ground works, more particularly for use in the substructure of pavements and the like.

The tray 100 has a planar base 102, an outer periphery 104 upstanding from said base 102, and internal walls 106 arranged to form a matrix on said base 102. The matrix defines a plurality of rectangular (preferably square) compartments 108 arranged in rows (x axis) and columns (y axis). In the preferred embodiment, the matrix has at least three or four columns and rows of square compartments 108.

The tray 100 is typically supplied in square or rectangular form and may be readily cut to form irregular shapes so as to be accommodated in situ adjacent existing objects or structures, such as at the corner of a building or a tree etc.

For domestic applications, the compartments on the tray may be as small as 100 mm square to 300 mm square with a depth of between 25 mm to 200 mm. Typical trays for domestic use

may be of a length in the region of 600 mm to 1500 mm , so as to be readily handled and transported in a car, for example. For larger scale applications, the compartments may be between 600 mm to 1500 mm with a depth of 150 mm to 1200 mm. The trays themselves may be supplied as square or rectangular sections of up to 3600 mm to 4800 mm in length, although trays of 1500 mm to 3000 mm in length may be more typical.

As can be seen from Figure 2, the tray 100 can be placed on a ground surface 110 (whether excavated or naturally existing) with its base 102 uppermost, wherein an upper layer of paving blocks 112, paving slabs 114 or granular material 116 etc can be supported by the tray 100. This can significantly reduce the amount of fill material required on site, wherein the periphery 104 of the tray 100 and its internal walls 106 support the upper layer above the ground surface 110.

The tray 100 can also be used with its base 102 lowermost, as shown in Figure 3, wherein the tray 100 is used to contain granular material 116 such as gravel, shingle, earth or bark or the like, typically below ground level. Conventional sub-base material may also be compacted into the compartments. An upper layer can then be applied to the tray, if desired.

The compartments 108 act to restrain fill material against lateral movement, and also spread the load across the base 102 to the subjacent ground.

In certain applications, the tray 100 can replace the need for a layer of sub-base material, for example, wherein the tray 100 itself acts as the entire substructure for an upper layer on a ground surface 110. However, it may be preferred to locate the tray 100 on a pre-compacted layer of sub-base material or the like.

As illustrated in Figure 4, a plurality of trays 100A, 100B, 100C can be used together to cover natural ground 118. When the base is uppermost, it may be preferred to support the trays 100 on pegs 120 which act as piles to transfer the load from the upper layer down into the natural ground 118. In the embodiment of Figure 4, an intermediate frame is also used between the trays 100 and the pegs 120, the frame including elongate strip-type supports in the form of inverted T sections, wherein the ends of the trays are supported on the flanges of the T-sections. The frame preferably supports the entire periphery of each tray 100, and may include inverted L-sections at the outer periphery of the array of trays 100. Such frames can

be of particular assistance in defining a level plane for the trays 100, as described in the applicant's co-pending International Patent Application based on British patent applications GB 0612393.9 and GB 0614679.9.

A modified tray is indicated at 122 in Figure 5, wherein a series of apertures 124 are formed in the outer periphery 104. These apertures 124 can be used for receiving pins 126 so as to interconnect adjacent trays 100A, 100B, 100C, as shown in Figure 6. Alternatively, the trays can be clipped together or simply abutted against one another *in situ*.

A further modified tray is indicated at 130 in Figure 7, wherein drainage apertures 132 are formed in the base 102, in this case in each compartment 108. The apertures 132 also reduce the volume of material required to produce the tray 130.

In the embodiment of Figures 8 and 9, the tray 140 includes drainage apertures 142 in its base 102 an array of service apertures 144 in its outer periphery 104 and internal walls 106. The service apertures are aligned for passing service cables and conduits through the tray, as required, and can be shaped and configured according to the service requirements of a particular application for the tray 140. However, the service apertures 144 may also provide a drainage function, particularly if the tray 140 is inclined *in situ*.

Plugs 146 can be used to block one or more of the apertures 142, 146, as required, to provide a watertight service void, for example.

In Figure 10, the tray 140 includes a cover 150 which can be clipped, welded or otherwise secured to the tray 140 to form closed compartments 108, providing further rigidity to the tray 140

The internal walls 106 of the trays 100 described herein act as struts or brace members, which increase the strength and rigidity of each tray, whilst also acting a lateral restraints (in common with the periphery 104) against the movement of material within the compartments 108. The tray as a whole is able to spread load from an overlaid layer and/or from within the compartments 108 to the subjacent ground if the tray is used with its base lowermost. As such, the trays are advantageous in that they can be used effectively to reduce or replace the need for sub-base material and thereby reduce the depth of excavation required in domestic

ground improvements such as patios, pathways and driveways, as well as in industrial structures such as forecourts, car parks and roads.

One or more diagonal walls can be included in one or more of the compartments of the trays described herein.

The trays can act as a ground reinforcement for use in other subsurface applications such as when constructing tennis courts or other recreational areas, replacing or reducing the need for excavation and/or sub-base material. The trays can be used as removable covers for underground chambers, such as for service ducts and man holes, in particular, but not exclusively, the box-type trays of Figure 10.

The trays are particularly advantageous in that they can be used to support an upper layer over voids or consolidation occurring in the subjacent ground after construction, that might otherwise lead to sag or rutting in the upper layer, wherein portions of the base can act as a bridge over said voids or consolidation.

Any combination of the various configurations, orientations, apertures, interconnections, shapes and sizes of the trays described and illustrated can be incorporated to suit particular site requirements.

Claims

1. A ground support member for use in the substructure of a paved surface, comprising a plastics tray having a rigid planar base and a rigid matrix upstanding from said base so as to define individual compartments on said base, wherein the tray is intended for use in supporting an upper layer of paving or the like.

2. A ground support member according to claim 1 wherein the base is intended to act as a support surface for an upper pavement layer.

3. A ground support member according to claim 1 or claim 2 wherein the matrix is in the form of a grid forming columns and rows of compartments.

4. A ground support member according to claim 3 wherein the matrix has at least three columns or rows of compartments.

5. A ground support member according to any of claims 1 to 4 wherein the matrix includes apertures arranged for the passage of service cables or conduits through the tray.

6. A ground support member according to any preceding claim wherein drainage apertures are provided in said base.

7. A ground support member according to any preceding claim wherein a cover is provided for securing over the compartments of said matrix.

8. A ground support member according to any preceding claim wherein the tray is supplied in rolled form.

9. A method of paving comprising the steps of locating at a subsurface location a plastics tray having a rigid planar base and a rigid matrix upstanding from said base so as to define individual compartments on said base, and laying an upper pavement surface over said tray.

10. A method according to claim 9 wherein the tray is located with its base uppermost.

11. A method according to claim 10 wherein the upper pavement surface is laid on the base of said tray.

12. A method according to claim 9 wherein the tray is located with its base lowermost and wherein fill material is compacted into said compartments before the upper pavement surface is laid.

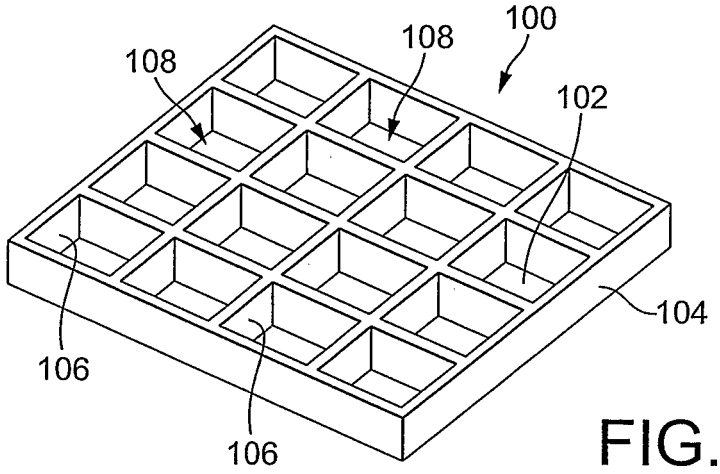


FIG. 1

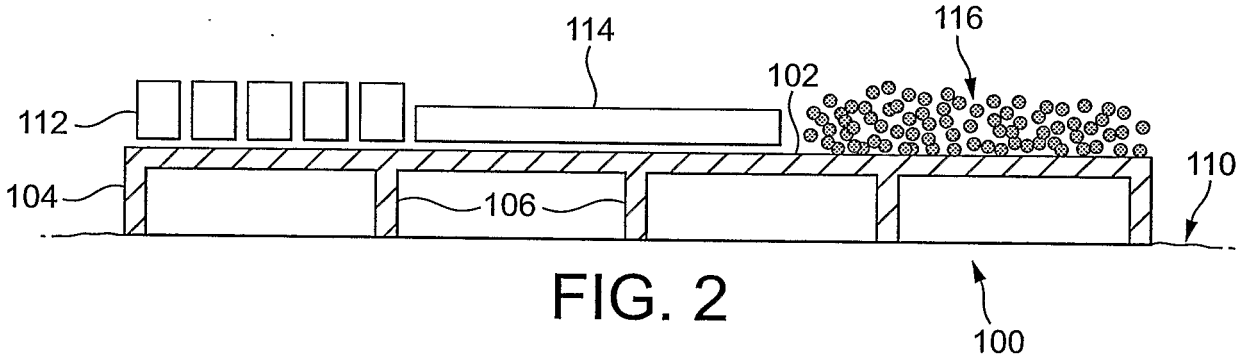


FIG. 2

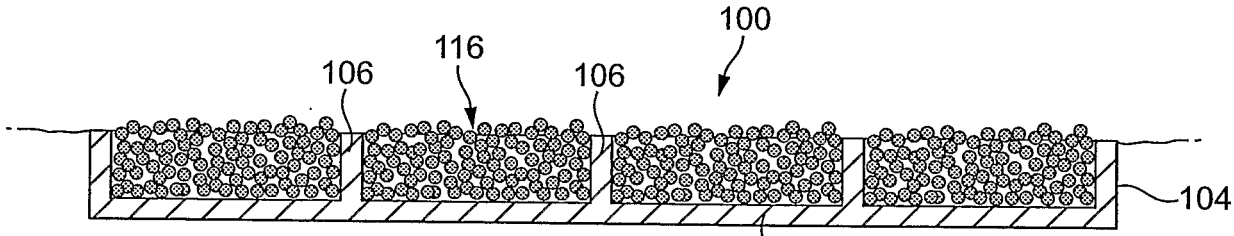


FIG. 3

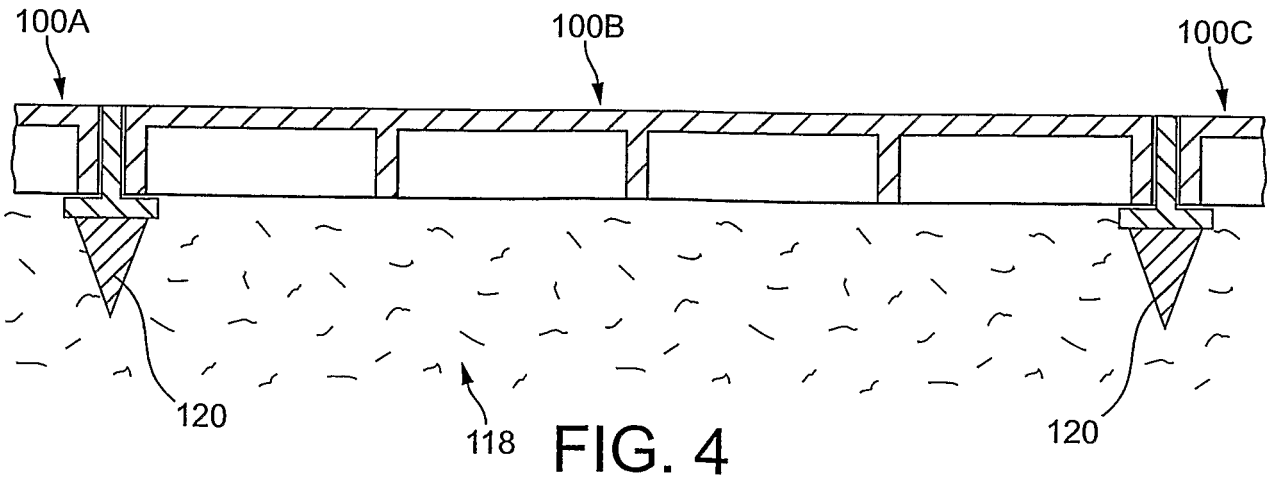


FIG. 4

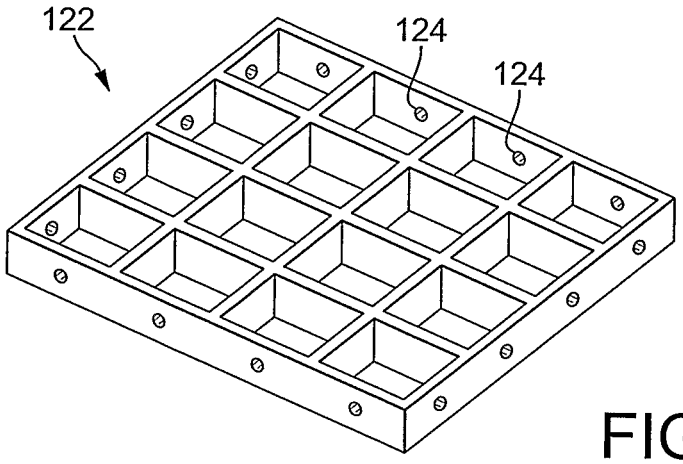


FIG. 5

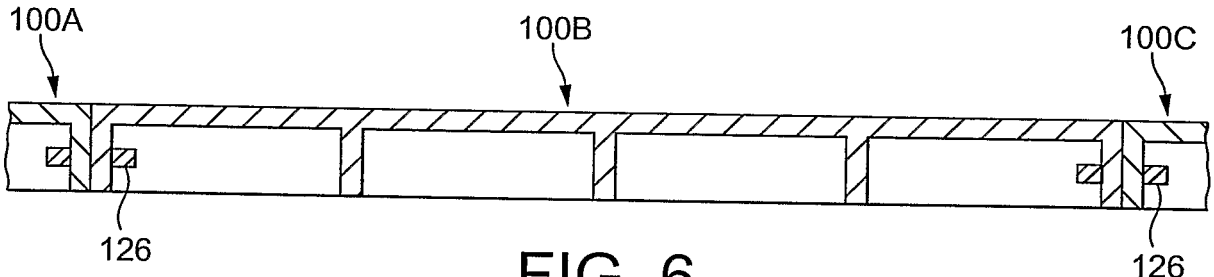


FIG. 6

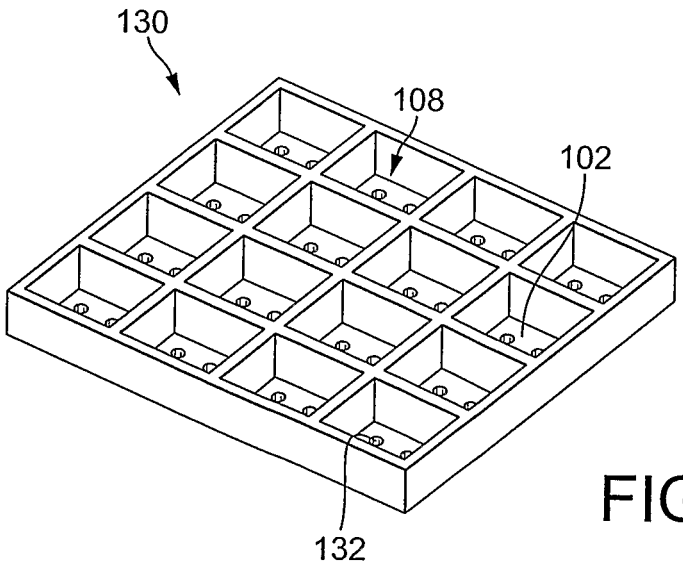


FIG. 7

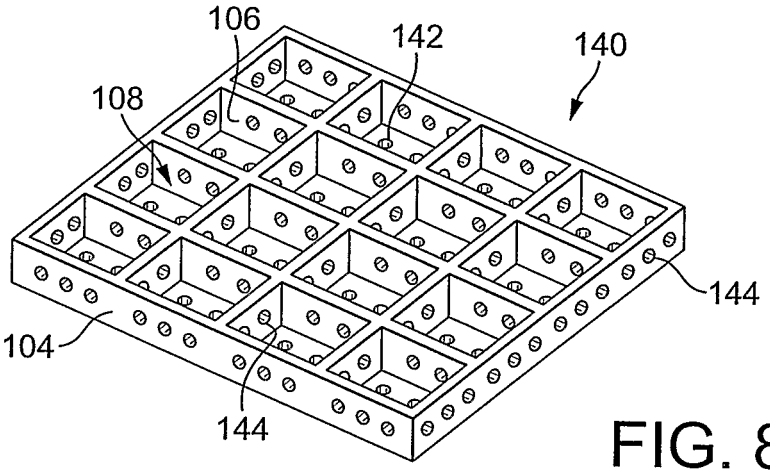


FIG. 8

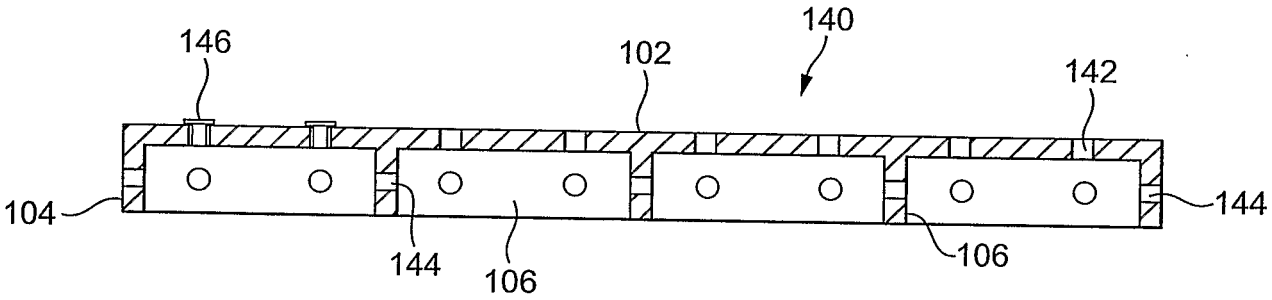


FIG. 9

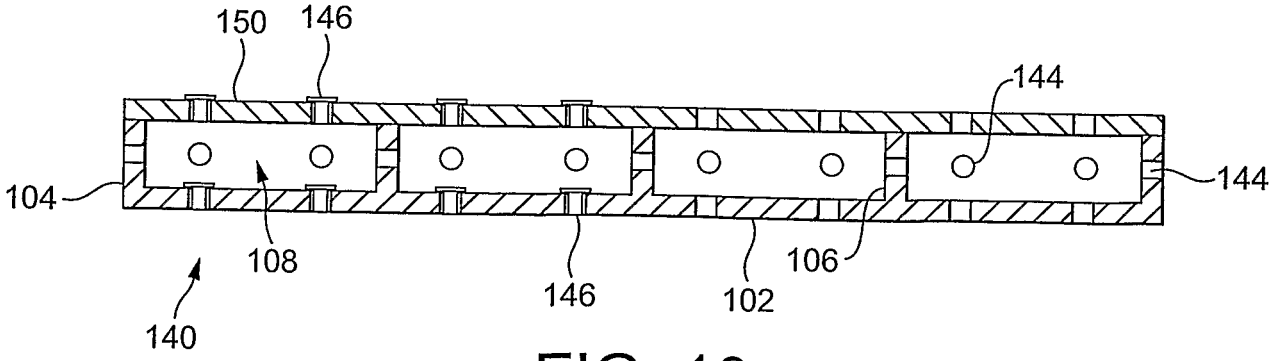


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/002329

A. CLASSIFICATION OF SUBJECT MATTER
INV. E01C5/00

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)
E01C

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 201 21 313 U1 (VEEH HELMUT [DE]) 1 August 2002 (2002-08-01) page 2, lines 18-23 page 3, lines 26-29 page 4, line 15 - page 5, line 27; figures 1-3	1-4,6,9
X	DE 40 18 377 A1 (ZIERER RUDOLF [DE]) 5 December 1991 (1991-12-05) the whole document	1-5,10, 11
X	WO 00/55429 A (HERGETH WILLIBALD [DE]) 21 September 2000 (2000-09-21) page 5, line 11 - page 8, line 27; figures 1-5	1-4,6-8

-/--

[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

"E" earlier document 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
5 October 2007	15/10/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	FLORES HOKKANEN, P

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/002329

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 197 20 006 A1 (HERGETH WILLIBALD [DE]) 26 November 1998 (1998-11-26) column 3, line 66 - column 4, line 2 column 4, line 19 - column 6, line 33; figures 1-4	1-4,6, 10,11
A	WO 02/14608 A (SITE ELECTRICAL PH LTD [GB]; MARSHALL RICHARD GRANVILLE [IE]) 21 February 2002 (2002-02-21) page 1, line 22 page 11, line 14 - page 12, line 23; figures 1,9,23,24	1,9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2007/002329

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 20121313 U1	01-08-2002	NONE	
DE 4018377 A1	05-12-1991	NONE	
WO 0055429 A	21-09-2000	AT 277229 T	15-10-2004
		AU 3550600 A	04-10-2000
		DE 10080633 D2	14-02-2002
		DE 19911409 A1	21-09-2000
		EP 1177347 A1	06-02-2002
		US 6694672 B1	24-02-2004
DE 19720006 A1	26-11-1998	NONE	
WO 0214608 A	21-02-2002	AU 8240801 A	25-02-2002
		CA 2457135 A1	21-02-2002
		EP 1311727 A1	21-05-2003
		US 2003188505 A1	09-10-2003
		US 2007186499 A1	16-08-2007