



(51) International Patent Classification:

E02B 3/12 (2006.01) *E04H 4/00* (2006.01)
E02B 3/16 (2006.01)

(21) International Application Number:

PCT/IB2024/056482

(22) International Filing Date:

03 July 2024 (03.07.2024)

(25) Filing Language:

Italian

(26) Publication Language:

English

(30) Priority Data:

102023000013935 04 July 2023 (04.07.2023) IT

(71) Applicant: **CARPI TECH B.V.** [NL/NL]; Bredaseweg
185, 4872 LA Etten-Leur (NL).

(72) Inventor: **SCUERO, Alberto, Maria**; CARPI TECH B.V.,
Bredaseweg 185, 4872 LA Etten-Leur (NL).

(74) Agent: **CRUGNOLA, Pietro** et al.; Luppi IP S.r.l., Viale
Corassori 54, 41124 Modena (IT).

(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, CV, CZ, DE, DJ, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG,
KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY,
MA, MD, MG, MK, MN, MU, 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.

(54) Title: METHOD AND DEVICE FOR IMPERMEABILIZING THE BOTTOM OF A WATER BASIN

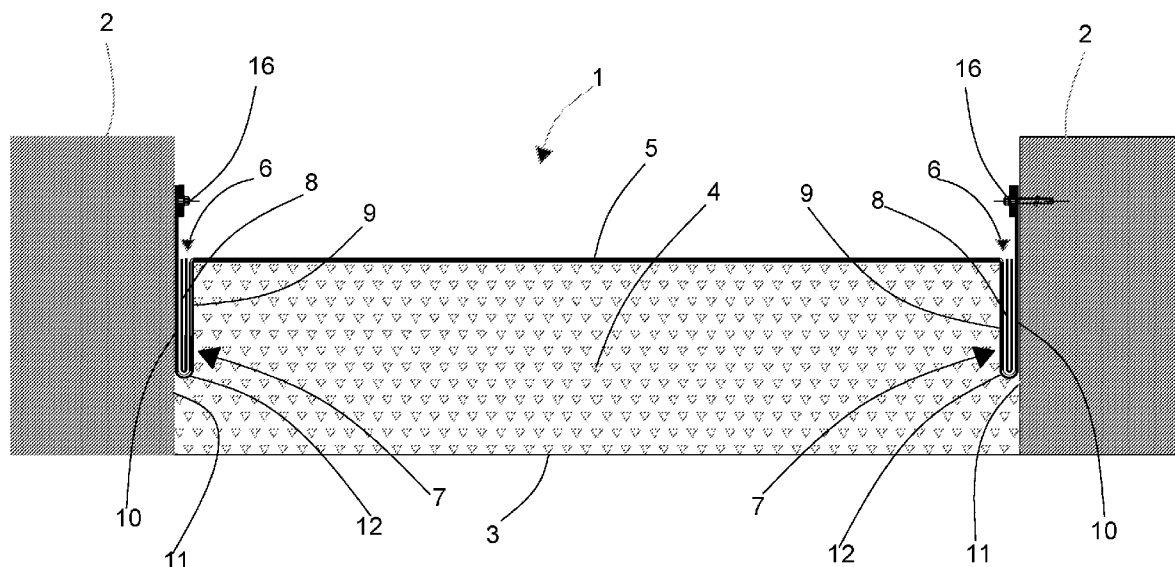


Fig. 1

(57) Abstract: A method for impermeabilizing the bottom (3) of a water basin (1) provided with banks (2) made of concrete or natural soil, comprising spreading a substrate (4) of inert mineral materials on the bottom (3) of the water basin (1) comprising the following steps: - making respective grooves (6) in respective interface zones (11) between the substrate (4) and the banks (2) of the water basin (1), wherein each groove extends longitudinally along a respective bank (2); - spreading an impermeable covering element (5) on the substrate (4) and inserting the impermeable covering element (5) in said respective grooves (6), forming a respective bend (7) in each groove (6); - fixing the impermeable covering element (5) to the banks (2) of the water basin (1) using fixing elements (16). An impermeabilization device for impermeabilizing a bottom (3) of a body of water (1) comprising an impermeable covering element (5), configured to be spread on a substrate (4) made of inert mineral materials spread on the bottom (3) of a water basin (1), comprising at least one support layer (13) and an impermeable layer made of composite material (14), characterised in that a portion of said impermeable covering element is folded in order to form a bend (7), which can be inserted into a groove (6) which extends into an interface zone between the bottom (3) and banks (2) of the water basin (1).

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, 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, ME, 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).

Published:

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

Method and device for impermeabilizing the bottom of a water basin**BACKGROUND OF THE INVENTION**

5 [0001] The present invention relates to a method and to a device for impermeabilizing natural or artificial water basins with natural soil or concrete banks, in which the bottom and the banks of the basin can be subjected to deformations caused by the interaction with the water in the basin, by differential settlements, due to seismic events or other causes, which produce relative movements between the concrete banks and the bottom of the basin which
10 generally consists of soil or rock, which are covered with a base layer of mineral substances to obtain a flat, compact and homogeneous bottom.

STATE OF THE ART

[0002] Impermeabilizing the bottom of artificial or natural basins by spreading on the bottom of the basin an impermeable membrane, which extends up to the banks of the basin, for
15 example banks made of concrete, or made of excavated and therefore strongly consolidated material, to which the membrane is anchored, is known.

[0003] The bottom of the basin may be covered by a base layer of mineral substances, so as to obtain a flat, compact, and homogeneous smooth substrate on which the impermeable membrane can be spread and fixed or simply placed.

20 [0004] The banks of the basin and the substrate on the bottom of the basin behave differently towards mechanical stresses, for example due to ground settlement movements, caused and not caused by the action of the water present in the basin, or by telluric movements.

[0005] As a matter of fact, the banks of the basin are relatively rigid, while the substrate on the bottom of the basin can be considered as an elastic layer; therefore, the deformations to
25 which the substrate is subjected on the bottom of the basin due to the mechanical stresses are much higher, considering the same stresses, than the deformations of the banks.

[0006] Upon the occurrence of the deformations mentioned above, as a result this leads to the impermeable membrane, which is integral with the substrate on the bottom of the basin for possible anchoring systems or ballast, for water load and the banks, being subjected to
30 deformation stresses which may also reach values such to cause breaking of the impermeable membrane, with resulting loss of impermeabilization of the bottom of the basin.

[0007] An object of the present invention is providing an impermeabilization of the bottom of a natural or artificial water basin by means of an impermeable membrane, eliminating the

risk of breaking of the impermeable membrane, due to deformations of different magnitude, to which the bottom of the basin and the banks are subjected to, due to mechanical stresses.

SUMMARY OF THE INVENTION

[0008] The object of the invention is achieved through a method for impermeabilizing the bottom of a water basin according to claim 1, as well as through an impermeabilization device according to claim 6.

In particular, according to a first aspect of the invention, there is provided a method for impermeabilizing the bottom of a water basin which envisages providing a groove in the interface zone between the bottom and the banks of the basin, spreading an impermeable covering element on the bottom of the basin, inserting the impermeable covering element into said groove, forming a bend, and fixing the impermeable covering element to the banks of the basin using fixing means.

According to another aspect of the invention there is provided an impermeabilization device comprising at least one support layer and an impermeable layer made of composite material, wherein an area of the covering device is folded to form a bend and it is inserted into a groove which extends into an interface zone between the bottom and the banks of the basin. The presence of the bend in the impermeable cover, inserted into a groove in the interface zone between the bottom and the banks of the basin, enables the impermeable cover to compensate for any deformations of different magnitude which may occur in the bottom and in the banks of the basin. As a matter of fact, the bend allows the membrane to extend, due to the deformations mentioned above, without being subjected to tensile stresses, therefore eliminating the risk of breaking of the membrane.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Further characteristics and advantages of the invention will be apparent from the description of embodiments of the invention below, provided by way of non-limiting example, with reference to the attached drawings, wherein:

figure 1 is a schematic cross-sectional view of the bottom and of the banks of a water basin, which shows the installation of an impermeable covering device according to the invention;

figure 2 is an enlarged detail of figure 1;

figure 3 is a cross-section like that of figure 1, which shows a variant of the installation of an impermeable covering device according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0010] Figure 1 schematically shows a cross-section of a water basin 1, with concrete banks 2.

[0011] On a bottom 3 of the water basin 1 there is spread a substrate 4 made of inert mineral material, on which there is spread an impermeable covering element 5 consisting of a highly flexible geomembrane 14 made of composite material, comprising, for example, a layer of PVC, PVC with ELVALOY, TPO, or EPDM, which can be heat-laminated with a layer of non-woven geotextile material. A layer 13 of support material consisting of an ultra-low deformability technical textile material which acts as mechanical support to the geomembrane 14 is positioned beneath the geomembrane 14.

[0012] The technical textile material may be a woven geosynthetic material comprising high tenacity polypropylene multifilament yarns, woven in a stable mesh to maintain their relative position.

[0013] Two respective grooves 6, which extend longitudinally along the banks 2 are provided in the interface zones 11 between the substrate 4 and the banks 2 of the water basin 1.

[0014] The impermeable covering element 5 is inserted into said grooves 6, so as to form, in each of them a respective bend 7 comprising a first rectilinear portion 9, facing the substrate 4, a second rectilinear portion 10, facing the bank 2 and a curvilinear portion 12 which connects the first rectilinear portion 9, with the second rectilinear portion 10.

[0015] Each bend 7 forms an accumulation portion of the impermeable covering element, suitable for compensating for the relative movements between the substrate 4 and the banks 2, for example due to ground settlement movements, due to the action of the water present in the basin, or due to telluric movements.

[0016] In each groove 6, between the first rectilinear portion 9 and the second rectilinear portion 10 of the bend 7, there is arranged a strip 8 made of non-woven geotextile material, or other material with low coefficient of friction for example PTFE, folded on itself in order to form a further bend, positioned to keep separate the mutually facing surfaces of the bend 7, that is the mutually facing surfaces of the first rectilinear portion 9 and of the second rectilinear portion 10.

[0017] The strip 8 made of non-woven geotextile material has a low coefficient of friction and it is arranged for facilitating the mutual sliding of said mutually facing surfaces of the bend 7 avoiding damage and wear thereto and allowing the first rectilinear portion 9 and the second rectilinear portion 10 of the bend 7 to slide one with respect to the other substantially without friction, so that the impermeable covering element 5 can move to compensate for

the deformations of the substrate 4 and of the banks 2, without being subjected to tensile stresses which could jeopardise the integrity thereof.

[0018] The impermeable covering element 5 is fixed to the banks 12 through a plurality of fixing elements 16, for example comprising a metal profile for distributing the forces fixed with metal pins spaced apart from each other with a substantially constant pitch and fixed in a per se known manner in corresponding holes made in the banks 2 of the water basin.

[0019] Figure 3 shows a variant of the method according to the invention, which provides for spreading on the covering element 5 a layer 15 of ballast made of impermeabilizing material, for example bituminous concrete, or cement-based concrete, so that the covering element 5 is blocked between the substrate 4 and the layer 15 made of impermeabilizing material.

[0020] In this case, the geomembrane 14 made of composite material may consist of a membrane made of PVC, PVC with ELVALOY, TPO, or laminated EPDM, on both faces, with a layer of non-woven geotextile material.

[0021] The impermeabilizing material of the ballast layer 15, when it is spread on the geomembrane 14 soaks up the fibres of the upper layer of non-woven geotextile material, obtaining an impermeable bond between the two materials.

[0022] The present invention may also be used for the connection between two rigid structures, which can move independently with respect to each other, wherein the substrate 4 may consist of plastic, bituminous or granular material, which may deteriorate over time to the point of no longer being present and therefore obtaining a void cavity. In this case the reinforcing layer 13 made of non-woven geotextile material prevents the geomembrane 14 from deforming beyond the breaking limit.

[0023] In this solution, the bottom 3 could consist of bituminous mastic or a PVC or copper waterstop.

CLAIMS

1. A method for impermeabilizing the bottom (3) of a water basin (1) comprising spreading a substrate (4) of inert mineral materials on the bottom (3) of the water basin (1),
5 characterized in that it comprises the following steps:

- making respective grooves (6) in respective interface zones (11) between the substrate (4) and banks (2) of the water basin (1), wherein each groove extends longitudinally along a respective bank (2);
- spreading an impermeable covering element (5) on the substrate (4) and inserting the
10 impermeable covering element (5) into said respective grooves (6), forming in each groove (6) a respective bend (7), that forms an accumulation portion of the impermeable covering element (5), suitable for compensating relative movements between the substrate (4) and the banks (2);
- inserting into each of said grooves (6), between a first rectilinear portion (9) and a second
15 rectilinear portion (10) of the respective bend (7), a strip (8) made of non-woven geotextile material, or of PTFE, or equivalent material, folded on itself, positioned for keeping separate the mutually facing surfaces of the bend (7), wherein the strip (8) made of non-woven geotextile material or of PTFE, has a low coefficient of friction and it is arranged for facilitating mutual sliding of said mutually facing surfaces of said bend (7), avoiding
20 damage/wear thereto;
- fixing the impermeable covering element (5) to the banks (2) of the water basing (1) using fixing elements (16).

2. Method according to claim 1, comprising making the impermeable covering element
25 (5) with a geomembrane (14) comprising a layer of PVC, PVC with ELVALOY, TPO, or EPDM.

3. Method according to claim 2, further comprising heat laminating on said layer of PVC, PVC with ELVALOY, TPO, or EPDM, at least one layer of non-woven geotextile
30 material.

4. Method according to claim 3, further comprising heat laminating on opposite faces of said layer of PVC, PVC with ELVALOY, TPO, or EPDM, a respective layer of non-

woven geotextile material.

5. Method according to one of claims 2 to 4, further comprising positioning the geomembrane (14) on an underlying reinforcing layer (13) made of technical textile material.

6. Method according to one of the preceding claims, further comprising spreading a layer (15) of impermeabilizing material on the impermeable covering element (5).

7. Impermeabilization device for impermeabilizing a bottom (3) of a water basin (1) comprising an impermeable covering element (5), configured to be spread on a substrate (4) of inert mineral materials spread on a bottom (3) of the water basin (1), comprising at least one support layer (13) and an impermeable layer made of composite material (14), characterised in that a portion of said impermeable covering element is folded to form a bend (7), which can be inserted into a groove (6) which extends into an interface zone (11) between the bottom (3) and banks (2) of the water basin (1); wherein between a first rectilinear portion (9) and a second rectilinear portion (10) of said bend (7) a strip (8) of non-woven geotextile material, or of PTFE, or of equivalent material, folded on itself is inserted, positioned for keeping separate the mutually facing surfaces of the bend (7), wherein the strip (8) made of non-woven geotextile material or of PTFE, or of equivalent material has a low coefficient of friction and it is arranged for facilitating the mutual sliding of said mutually facing surfaces of said bend (7), preventing damage or wear thereto.

8. Impermeabilization device according to claim 7, wherein the impermeable covering element (5) comprises a geomembrane (14) comprising a layer of PVC, PVC with ELVALOY, TPO, or EPDM.

9. Impermeabilization device according to claim 8, wherein at least one layer of non-woven geotextile material is heat-laminated on said layer of PVC, PVC with ELVALOY, TPO, or EPDM.

10. Impermeabilization device according to claim 9, wherein a respective layer of non-woven geotextile material is heat-laminated on opposite faces of said layer of PVC, PVC with ELVALOY, TPO, or EPDM.

11. Impermeabilization device according to one of claims 8 to 10, wherein the geomembrane (14) is fixed to an underlying support layer (13) made of technical textile material.

5 **12.** Impermeabilization device according to one of claims 7 to 11, wherein the impermeable covering element (5) is fixed to the banks (2) of the body of water (1) using fixing elements (16).

10 **13.** Impermeabilization device according to one of claims 7 to 12, further comprising a layer (15) made of impermeabilizing material, spread on said impermeable covering element (5), in particular bituminous concrete or cement.

15 **14.** Impermeabilization device according to claim 15, wherein the non-woven geotextile material laminated on the geomembrane (14) is soaked up by the bituminous concrete or by the cement, creating a tenacious and impermeable bond between the two materials.

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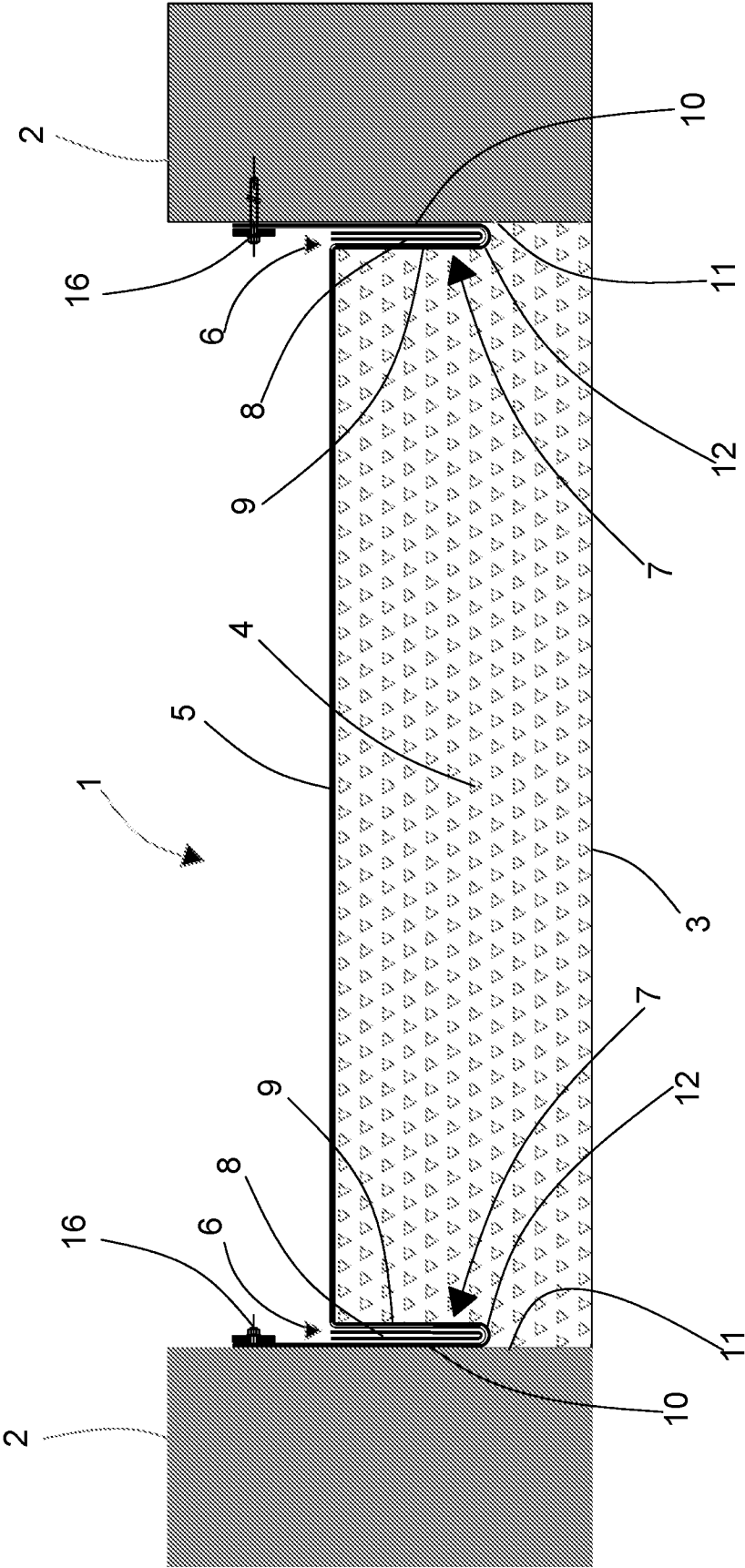
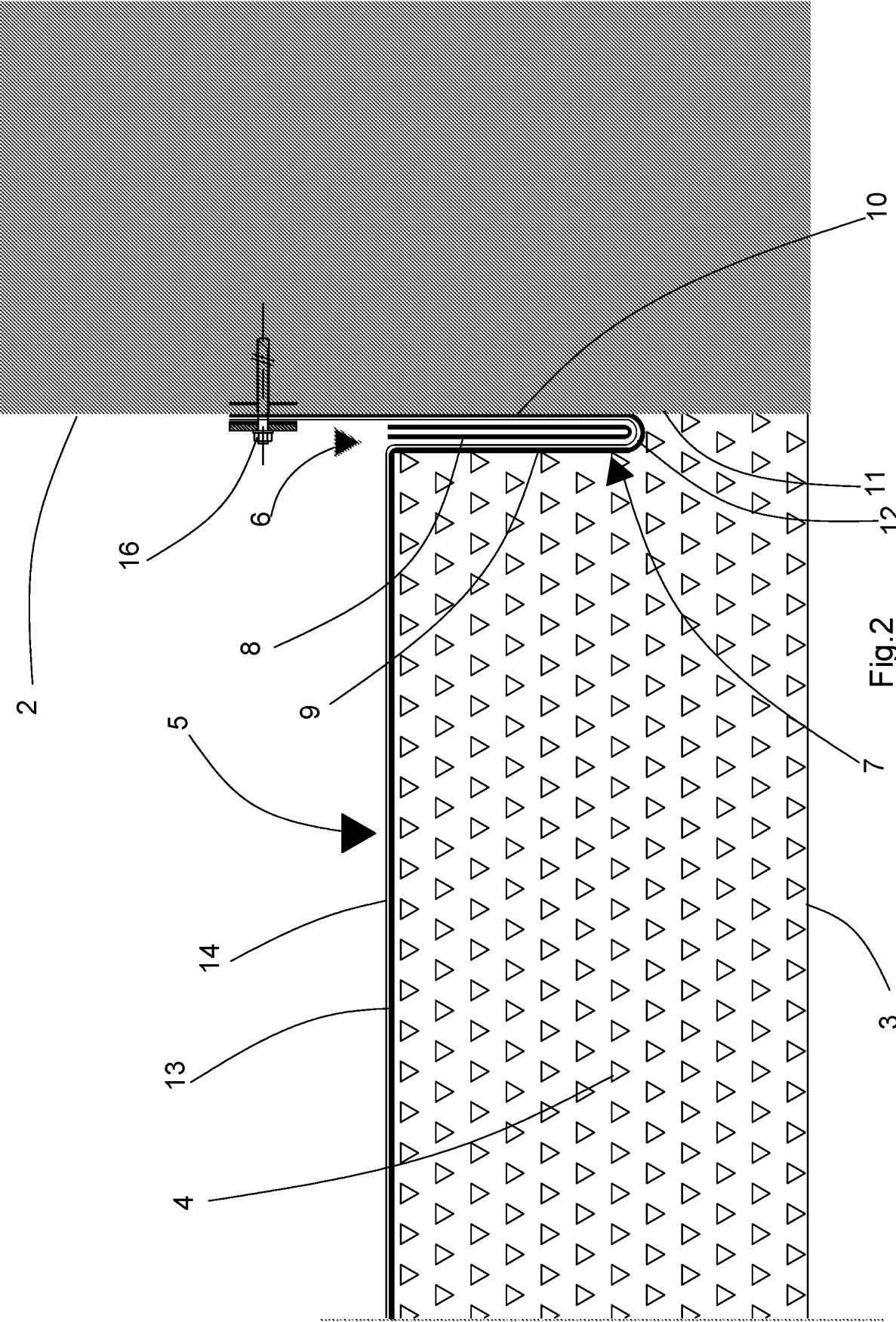


Fig. 1



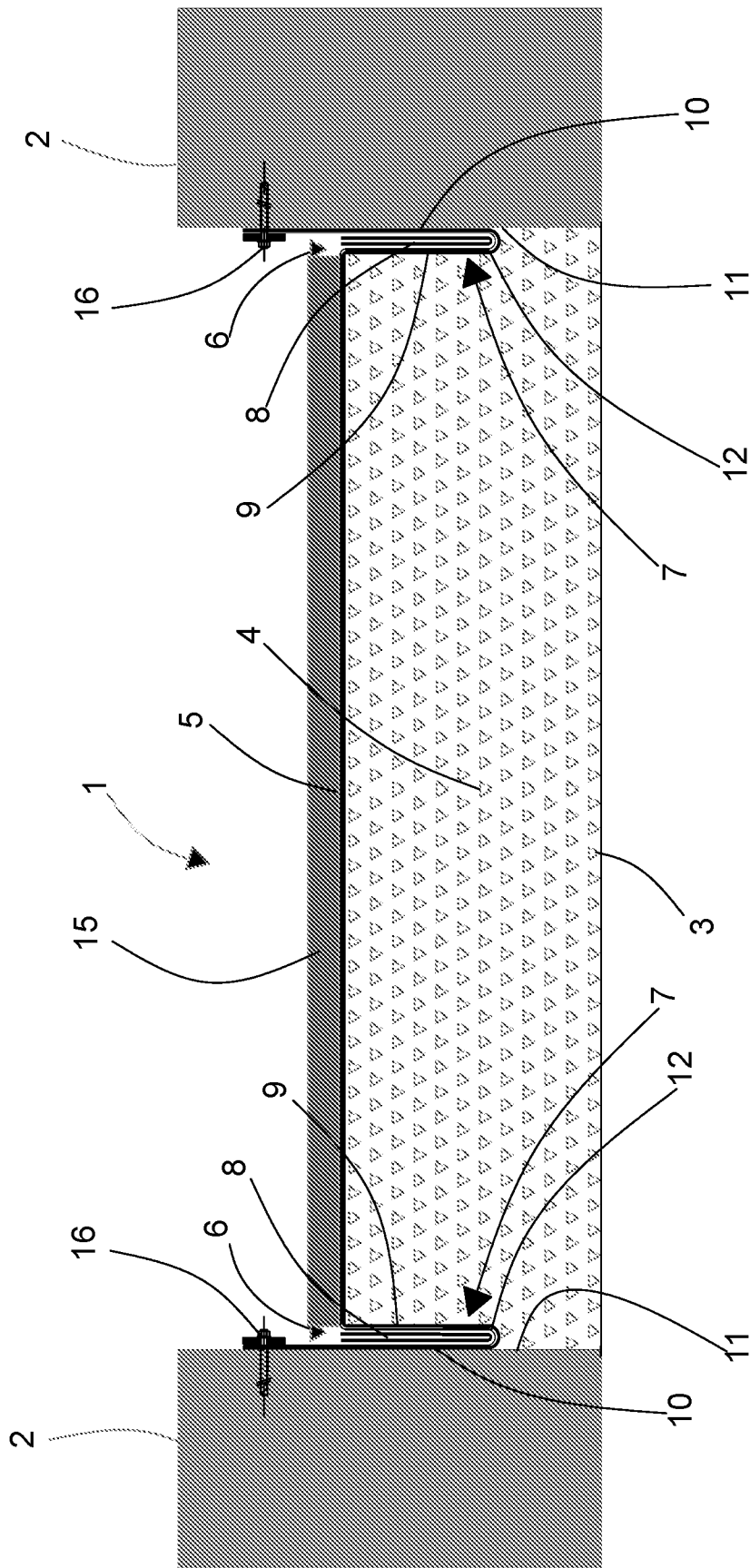


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/056482

A. CLASSIFICATION OF SUBJECT MATTER INV. E02B3/12 E02B3/16 E04H4/00 ADD.		
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) E02B E04H E04B 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) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2014/166996 A1 (CARPI TECH BV [NL]) 16 October 2014 (2014-10-16) page 9, line 10 - page 17; figures -----	1 - 14
A	US 9 903 082 B2 (POWERCHINA HUADONG ENGINEERING CORP LTD [CN]) 27 February 2018 (2018-02-27) column 5, line 16 - column 10, line 3; figures -----	1, 7
☐ Further documents are listed in the continuation of Box C. ☒ 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 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 26 September 2024		Date of mailing of the international search report 07/10/2024
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Zuurveld, Gerben

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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