



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
08.04.2020 Bulletin 2020/15

(51) Int Cl.:
E02B 3/14 (2006.01)

(21) Application number: **18000784.1**

(22) Date of filing: **03.10.2018**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **Vermeij, I.**
CH-5113 Holderbank (CH)
• **Quataert, J.P.**
CH-5113 Holderbank (CH)

(74) Representative: **Keschmann, Marc**
Haffner und Keschmann Patentanwälte GmbH
Schottengasse 3a
1010 Wien (AT)

(71) Applicant: **Holcim Technology Ltd**
8645 Jona (CH)

(54) **ASSEMBLY OF CONCRETE BLOCKS FOR COVERING A DYKE**

(57) In an assembly of concrete blocks for covering a dyke for protection against wave attacks, comprising at least two concrete blocks, each substantially having the form of a polygonal prism comprising a ground surface and a prism perimeter surface having a contiguous series of at least six side surfaces, in particular eight side surfaces, wherein the concrete blocks are placed at a distance from each other so as to form interstices be-

tween the blocks, at least two blocks are interconnected by means of a connecting beam integrally formed with said at least two blocks, said connecting beam having a ground surface that is aligned with the ground surface of said at least two blocks and having a height that corresponds to 50-80%, preferably 65-75%, of the height of said at least two blocks.

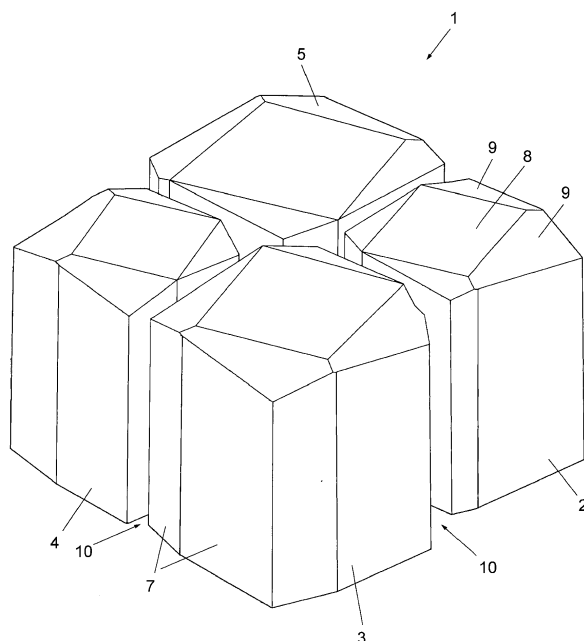


Fig. 1

Description

[0001] The invention refers to an assembly of concrete blocks for covering a dyke for protection against wave attacks, comprising at least two concrete blocks, each substantially having the form of a polygonal prism comprising a ground surface and a prism perimeter surface having a contiguous series of at least six side surfaces, in particular eight side surfaces, wherein the concrete blocks are placed at a distance from each other so as to form interstices between the blocks.

[0002] Further, the invention refers to a covering for a dyke for protection against wave attacks, comprising a plurality of concrete blocks arranged side by side, wherein the interstices between the blocks are filled with a granular material.

[0003] Dyke bodies are exposed to heavy loads due to the movements of waves and/or water. Where the waves are too high or the current too strong for a grass cover, setting a stone covering provides an enhanced stability. It has been common practice to make such coverings of stone blocks by using so-called basaltic columns of natural stone, each column having a cross-sectional area differing from that of a further column. The stone columns have been placed against each other so that they support each other. This resulted in a relatively smooth dyke cover with a much greater stability, as if the stones had simply been poured loose on the embankment.

[0004] Nowadays, it is common to use blocks made of concrete instead of natural stone, such as basalt. Concrete blocks for use as a protection of water banks have been described, e.g., in WO 2011/096795 A2. Concrete blocks may be produced as precast elements, so that their production may be done in a cost-efficient way and under controlled manufacturing conditions. Concrete blocks are usually laid onto the dyke by means of machines, that grab and lay a plurality of blocks at once so as to increase the working speed. After the laying process, the interstices between the individual blocks are filled with granular material that holds the stones in their position relative to each other by frictional forces and increases the stability of the covering. Further, the granular material ensures the permeability of the covering so that water can drain. A drawback of such a system, however, is that the granular material arranged between the blocks is gradually washed out over time by the forces acting upon the granular material by the waves. As the granular material is washed out, the stability of the covering reduces substantially. Thus, there is a constant need to replace the granular material that has been washed out by new material, which involves high costs.

[0005] In a covering as described, comprising a plurality of blocks with granular material being arranged in the interstices, the individual blocks are interlocked with the granular material being interposed. In contrast, another known system for covering dykes comprises a number of blocks that interlock directly with each other in a form-

locking manner resulting in a very rigid and stable structure that is able to spread the load on the covering to a bigger area. However, due to said direct interlocking system, sea water cannot easily flow off from the covering after a wave impact. Further, uplift forces can become high under the blocks of this interlocking system.

[0006] Therefore, the instant invention aims at improving a concrete block coverage of a dyke for protection against wave attacks, that reduces the wash-out of granular material and therefore provides an increased stability and reduced maintenance requirements.

[0007] In order to solve these and other objects, the invention provides an improved assembly of concrete blocks comprising at least two concrete blocks, wherein said at least two blocks are interconnected by means of a connecting beam integrally formed with said at least two blocks, said connecting beam having a ground surface that is aligned with the ground surface of said at least two blocks and having a height that corresponds to 50-80%, preferably 65-75%, of the height of said at least two blocks. By providing a rigid connection between at least two concrete blocks, a relative movement between said interconnected blocks is prevented so as to reduce the risk of a wash out of the granular material that is arranged in the interstices between the blocks. Further, the connection beams divide the interstices into smaller compartments, which results in additional lateral barriers that hold the granular material in place. This minimizes the wash-out of the granular material, wherein the increased stability resulting therefrom enables to achieve well protected and stabilized dykes with blocks having a reduced height, therefore reducing the overall material cost of the solution. Preferably, the blocks have a height of 30-40cm.

[0008] According to the invention, the height of the connecting beams is selected to be 50-80%, preferably 65-75%, of the total height of said at least two blocks, which proved to produce optimal results with regard to the prevention of a wash-out of granular material.

[0009] The total height of a block is defined as the perpendicular distance between the ground area of the block and its highest point. If the at least two blocks that are connected by means of a connecting beams are of different height, the average height of said two blocks is used as said total height.

[0010] It is important to arrange the connecting beams so that their ground surface is aligned with the ground surface of said at least two blocks, so that the assembly, including the connecting beams, has a common ground area, which preferably is designed as a flat surface. Otherwise, granular material would tend to ingress into a gap formed between the connecting beams and the bedding layer, which would result in an undesired raising of the blocks.

[0011] Preferably, each concrete block of the block assembly is connected to the adjoining concrete block by means of a connecting beam of the type mentioned above.

[0012] The invention provides an assembly of at least two concrete blocks that forms a rigid structure so that said assembly may be handled by a block laying machine in an easier way when compared to the handling of a corresponding plurality of loose blocks.

[0013] According to a preferred embodiment, the assembly comprises at least four concrete blocks arranged in a grid within a rectangular bounding box, each block substantially having the form of a polygonal prism comprising a ground surface and a prism perimeter surface having a contiguous series of at least six side surfaces, in particular eight side surfaces, wherein the concrete blocks are placed at a distance from each other so as to form interstices between the blocks, wherein two of said at least four blocks are each interconnected by means of a connecting beam integrally formed with said two blocks, said connecting beam having a ground surface that is aligned with the ground surface of said two blocks and having a height that corresponds to 50-80%, preferably 65-75%, of the height of said two blocks.

[0014] Preferably, the assembly consists of exactly four blocks arranged in a 2x2 grid within a rectangular bounding box.

[0015] Arranging the blocks of the assembly so that a rectangular bounding box is formed enables the placing of a plurality of such assemblies side by side in a regular pattern.

[0016] Preferably, the blocks have the shape of irregularly formed prisms, the polygonal base of the prism therefore having no symmetry and the edges of the polygonal base having different lengths. Preferably, the blocks are each formed as a right prism.

[0017] In particular, the blocks of an assembly are shaped differently from one another, so that no block is identical with another block within the assembly.

[0018] Preferably, the assembly comprises a first group of blocks and a second group of blocks, the blocks of the first group having a larger prism perimeter than the blocks of the second group, wherein blocks of the first group and blocks of the second group are preferably arranged alternately.

[0019] According to a preferred embodiment of the invention, four connecting beams are provided each connecting two of said four blocks that are arranged consecutively along the direction of an edge of the bounding box.

[0020] As mentioned above, the concrete blocks are placed at a distance from each other so as to form interstices between the blocks. According to a preferred embodiment, this means that the blocks of the assembly do not touch each other except where they are connected by said connecting beams.

[0021] Preferably, the connecting beams are extending parallel to the edges of the bounding box.

[0022] In order to achieve a sufficient draining capacity, the percentage of the open area, in a plan view, defined as the sum of the area of the interstices present between the blocks of the assembly and the interstices present between the blocks of the assembly and the bounding

box, with reference to the total area enclosed by the bounding box may be selected to be 10-15%, preferably, 12-13%.

[0023] In order to decrease the tendency of the granular material to be washed out, a preferred embodiment provides that two blocks that are interconnected by means of a connecting beam have opposed side surfaces confining at least one interstice between them, said opposed side surfaces extending in a non-parallel manner. In this way the interstice between two interconnected blocks narrows in one direction, which enhances the wedging effect and thus the friction between the granular material and the opposed side surfaces, said effect holding the granular material in place.

[0024] Preferably, two blocks that are interconnected by means of a connecting beam have opposed side surfaces confining a first interstice at one side of said connecting beam and a second interstice at the other side of said connecting beam, wherein the opposed side surfaces confining the first interstice are inclined relative to each other and the opposed side surfaces confining the second interstice are inclined relative to each other. Such an embodiment also results in the interstices having a narrowing geometry that increases the wedging of the granular material.

[0025] While increasing the open area of the assembly results in a desirable permeability for water, this also increases the risk of the bedding material arranged below the blocks to enter into the interstices from below. In order to prevent the bedding material from intruding into the interstices, a preferred embodiment provides that the interstices, in a plan view, are designed to allow a maximum free space between the blocks corresponding to a circle having a diameter of 50mm, preferably 40 mm. Here, it is assumed that the bedding material comprises granular material that has a particle size of bigger than 40 mm or 50 mm respectively.

[0026] As known per se, the side surfaces of the blocks facing the outside of the assembly may taper inwardly from the bottom to the top, in order to facilitate the demoulding of the concrete block from the mould.

[0027] In order to effectively dissipate the kinetic energy that is acting on the blocks when waves occur, each block preferably comprises a top surface and inclined surfaces each connecting an edge of the top surface with the side surfaces.

[0028] Preferably, the top surface has the shape of a rectangle that, in a top view, is arranged at an acute angle with respect to the bounding box.

[0029] The concrete blocks are preferably made of a concrete that has a high compressive strength. In particular, the compressive strength of the blocks after 28 days of curing is $> 60 \text{ N/mm}^2$.

[0030] According to a second aspect of the invention, a covering for a dyke for protection against wave attacks is provided, comprising a plurality of assemblies of concrete blocks as described above that are arranged side by side, wherein the interstices between the blocks of

each assembly and the interstices between adjoining assemblies are filled with a granular material.

[0031] Preferably, the side by side arrangement is configured such that the blocks of one assembly rest against the blocks of the adjoining assembly, thereby increasing the overall stability of the covering.

[0032] Preferably, the assemblies of concrete blocks are arranged on a filter layer comprising a granular material, said filter layer preferably being arranged on a geotextile and said geotextile preferably being arranged on a layer of clay.

[0033] Preferably, the granular material arranged within the interstices has a particle size of between 4 and 32 mm, preferably 16 and 32 mm.

[0034] In order to increase the stability of the covering, a granular material having a particularly high mass is used. Preferably, the granular material arranged within the interstices has a volumetric mass density of $> 2'800 \text{ kg/m}^3$, preferably $2'900\text{--}3'000 \text{ kg/m}^3$.

[0035] Preferably, the granular material arranged within the interstices is made of crushed or broken stone, preferably basalt. Crushed or broken stone is characterized by an irregular shape, which enhances the interlocking effect prevailing between the stones.

[0036] Preferably, the granular material of the filter layer has a particle size distribution characterized by a $D_{90} > 50 \text{ mm}$.

[0037] In particular, the interstices between the blocks of each assembly and the interstices between adjoining assemblies are dimensioned so as to prevent ingress of the granular material of the filter layer.

[0038] The inventive covering and the inventive assembly of blocks can not only be used for covering dykes, but for covering any water-exposed slopes in general, such as banks, coasts, etc.

[0039] The invention will now be described in more detail by reference to an exemplary embodiment illustrated in the attached drawings. In the drawings, Fig. 1 shows a perspective view of an assembly consisting of four blocks, Fig. 2 is a top view of the assembly of Fig. 1, Fig. 3 is a sectional view along the line A-A of Fig. 2, Fig. 4 is a sectional view along the line B-B of Fig. 2, Fig. 5 is a sectional view along the line C-C of Fig. 2, Fig. 6 is a top view of a plurality of assemblies of Fig. 1 arranged side by side and Fig. 7 is a sectional view of a dyke with an inventive covering.

[0040] Fig. 1 illustrates an assembly 1 of four concrete blocks 2, 3, 4 and 5. The blocks are each formed as right prisms having an irregularly formed polygonal ground surface 6 and a prism perimeter surface having a contiguous series of eight side surfaces 7. The blocks have a rectangular top surface 8 that extends parallel to the ground surface 6. The top surface 8 is smaller than the ground surface 6, wherein inclined surfaces 9 each connect an edge of the top surface 8 with two adjoining side surfaces 7.

[0041] The concrete blocks are placed at a distance from each other so as to form interstices 10 and 11 be-

tween the blocks, as can be seen in the top view according to Fig. 2. The blocks 2, 3, 4 and 5 are arranged in a grid of 2×2 blocks, wherein adjoining blocks are each interconnected by means of a connecting beam 12, 13, 14 and 15. In particular, blocks 2 and 3 are interconnected by a connecting beam 13, and blocks 3 and 4 are interconnected by a connecting beam 14, and blocks 4 and 5 are interconnected by a connecting beam 15, and blocks 5 and 2 are interconnected by a connecting beam 12. In this way, the blocks and the connecting beams together form a rigid ring-like structure, wherein the four blocks and the four connecting beams are cast as one single piece. The diagonally arranged blocks 2 and 5 are smaller than the diagonally arranged blocks 3 and 4.

[0042] A first group of interstices 10 is formed on the exterior side of the connecting beams and a second group of interstices 11 is formed on the interior side of the connecting beams, wherein the interstices 11 are joined to form a single central compartment.

[0043] As can be seen in Fig. 2 the blocks 2, 3, 4 and 5 of assembly 1 are arranged within the rectangular bounding box 16, which facilitates the arrangement of a plurality of assemblies 1 as depicted in Fig. 6. The assemblies 1 are placed side by side in a manner that adjoining assemblies rest against each other except of block 4, which comprises a lateral extension beam 17, which rests against block 3 of an adjoining assembly. As can be seen in Fig. 6, interstices 18 are formed between the blocks of adjoining assemblies 1. Further, Fig. 6 shows that the blocks of adjoining assemblies interlock with each other by having edges of the blocks of one assembly extending into the bounding box of an adjoining assembly.

[0044] The open area of the dyke covering that is formed by the plurality of assemblies 1 is defined as the percentage of the accumulated areas, in a top view, of the interstices 10, 11 and 18, with reference to the total area covered by the assemblies or their bounding boxes respectively. In the present example, the open area is 12.35 %.

[0045] The open area, in a top view, is shaped so as to prevent the granular material of a filter layer arranged below the blocks from entering into the interstices. Therefore, the interstices 10, 11, and 18 allow for a maximum free space between the blocks corresponding to a circle having a diameter of d , as shown in Fig. 2, which in the present example is 50 mm.

[0046] The connecting beams are integrally formed with the blocks that they interconnect and have a ground surface that is aligned with the ground surface of the blocks. Further, the connecting beams have a height that corresponds to 50-80%; preferably 65-75%, of the height of the blocks, as can be seen in the cross sectional view according to Fig. 3. The same applies for the lateral extension beam 17 as shown in Fig. 4.

[0047] Fig. 5 illustrates that the transition from a connecting beam 12 to the adjoining concrete blocks 2 and 5 is formed by a sharp edge x , i.e. a right angle. The

same applies to the other connecting beams 13, 14 and 15 and for the extension beam 17.

[0048] Fig. 7 illustrates a dyke 19 that has a covering consisting of a base layer 20 of clay, a geotextile arranged on the layer 20, a filter layer 21 consisting of a granular bed material and a layer 22 of assemblies 1 of blocks.

[0049] The covering as shown in Fig. 7 was subjected to the following stability test. The test was conducted in an artificial testing facility having a flume that is 300 m long, 5 m wide and 9.5 m deep. Waves can be generated with a significant wave height of up to 2 m, with individual highest waves up to 5 m. The stability of the covering in wave attacks must be tested on a large scale, because the damage mechanism is highly influenced by scale effects.

[0050] The objective of the investigation was to determine the stability factor of the inventive covering.

[0051] The tests have been carried out on a scale of 1:1.5, which means that the dimensions of the blocks were 1.5 times smaller than in reality. Also the wave height was 1.5 times smaller than in reality. The slope angle and density of the blocks are on scale 1:1 according to the scaling laws derived from basic physics.

[0052] The dimensions of the scale model were as follows:

- slope angle: 1:3.6
- height of blocks: 0.199 m
- average density of blocks: 2262 kg/m³
- layer thickness of the filter layer 21: 0.08 m
- grain size of the granular material of the filter layer 21: 11-35 mm, $D_{15} = 13$ mm
- grain size of the granular material filled into the interstices of the assemblies 1: 5-20 mm, $D_{15} = 6$ mm

[0053] Three test series have been carried out:

Test 1: short duration tests with small wave steepness (relatively low waves)

Test 2: short duration test with large wave steepness (relatively short waves)

Test 3: long duration test with large wave steepness (relatively short waves).

[0054] In the first two test series the wave height has been increased step-by-step, starting at a significant wave height of 1.5 m and ending at 1.9 m. These were short duration tests of approximately 1.5 hours each (at least 1000 waves).

[0055] The third test series was a long duration test, lasting 26 hours.

No damage was identified at all after all of these tests. In particular, the wash-out of the granular material arranged in the interstices of the assemblies 1 was very low. The covering withstood the severe wave attack very well.

Claims

1. Assembly of concrete blocks for covering a dyke for protection against wave attacks, comprising at least two concrete blocks, each substantially having the form of a polygonal prism comprising a ground surface and a prism perimeter surface having a contiguous series of at least six side surfaces, in particular eight side surfaces, wherein the concrete blocks are placed at a distance from each other so as to form interstices between the blocks, wherein said at least two blocks are interconnected by means of a connecting beam integrally formed with said at least two blocks, said connecting beam having a ground surface that is aligned with the ground surface of said at least two blocks and having a height that corresponds to 50-80%, preferably 65-75%, of the height of said at least two blocks.
2. Assembly according to claim 1, wherein the assembly comprises at least four concrete blocks arranged in a grid within a rectangular bounding box, each block substantially having the form of a polygonal prism comprising a ground surface and a prism perimeter surface having a contiguous series of at least six side surfaces, in particular eight side surfaces, wherein the concrete blocks are placed at a distance from each other so as to form interstices between the blocks, wherein two of said at least four blocks are each interconnected by means of a connecting beam integrally formed with said two blocks, said connecting beam having a ground surface that is aligned with the ground surface of said two blocks and having a height that corresponds to 50-80%, preferably 65-75%, of the height of said two blocks.
3. Assembly according to claim 1 or 2, wherein the assembly consists of four blocks arranged in a 2x2 grid within a rectangular bounding box.
4. Assembly according to claim 2 or 3, wherein four connecting beams are provided, each connecting two of said four blocks that are arranged consecutively along the direction of an edge of the bounding box.
5. Assembly according to any one of claims 1 to 4, wherein the blocks of the assembly do not touch each other except where they are connected by said connecting beams.
6. Assembly according to any one of claims 2 to 5, wherein the connecting beams are extending parallel to the edges of the bounding box.
7. Assembly according to any one of claims 2 to 6, wherein the percentage of the open area, in a plan view, defined as the sum of the area of the interstices

present between the blocks of the assembly and the interstices present between the blocks of the assembly and the bounding box, with reference to the total area enclosed by the bounding box is 10-15%, preferably, 12-13%.

8. Assembly according to any one of claims 1 to 7, wherein the assembly comprises a first group of blocks and a second group of blocks, the blocks of the first group having a larger prism perimeter than the blocks of the second group, wherein blocks of the first group and blocks of the second group are preferably arranged alternately.

9. Assembly according to any one of claims 1 to 8, wherein two blocks that are interconnected by means of a connecting beam have opposed side surfaces confining at least one interstice between them, said opposed side surfaces extending in a non-parallel manner.

10. Assembly according to any one of claims 1 to 9, wherein two blocks that are interconnected by means of a connecting beam have opposed side surfaces confining a first interstice at one side of said connecting beam and a second interstice at the other side of said connecting beam, wherein the opposed side surfaces confining the first interstice are inclined relative to each other and the opposed side surfaces confining the second interstice are inclined relative to each other.

11. Assembly according to any one of claims 1 to 9, wherein the interstices, in a plan view, are designed to allow a maximum free space between the blocks corresponding to a circle having a diameter of 50mm, preferably 40mm.

12. Assembly according to any one of claims 1 to 11, wherein the side surfaces of the blocks facing the outside of the assembly taper inwardly from the bottom to the top.

13. Assembly according to any one of claims 1 to 12, wherein each block comprises a top surface and inclined surfaces each connecting an edge of the top surface with the side surfaces.

14. Assembly according to claim 13, wherein the top surface has the shape of a rectangle that, in a top view, is arranged at an acute angle with respect to the bounding box.

15. Covering for a dyke for protection against wave attacks, comprising a plurality of assemblies of concrete blocks according to any one of claims 1 to 14 arranged side by side, wherein the interstices between the blocks of each assembly and the interstices

between adjoining assemblies are filled with a granular material.

5 16. Covering according to claim 15, wherein the assemblies of concrete blocks are arranged on a filter layer comprising a granular material, said filter layer preferably being arranged on a geotextile and said geotextile preferably being arranged on a layer of clay.

10 17. Covering according to claim 15 or 16, wherein the granular material arranged within the interstices has a particle size of between 4 and 32 mm, preferably 16 and 32 mm.

15 18. Covering according to claim 15, 16 or 17, wherein the granular material arranged within the interstices has a volumetric mass density of $> 2'800 \text{ kg/m}^3$, preferably $2'900\text{-}3'000 \text{ kg/m}^3$.

20 19. Covering according to any one of claims 15 to 18, wherein the granular material arranged within the interstices is made of crushed or broken stone, preferably basalt.

25 20. Covering according to any one of claims 16 to 19, wherein the granular material of the filter layer has a particle size distribution **characterized by** a $D_{90} > 50\text{mm}$.

30 21. Covering according to any one of claims 16 to 20, wherein the interstices between the blocks of each assembly and the interstices between adjoining assemblies are dimensioned so as to prevent ingress of the granular material of the filter layer.

35

40

45

50

55

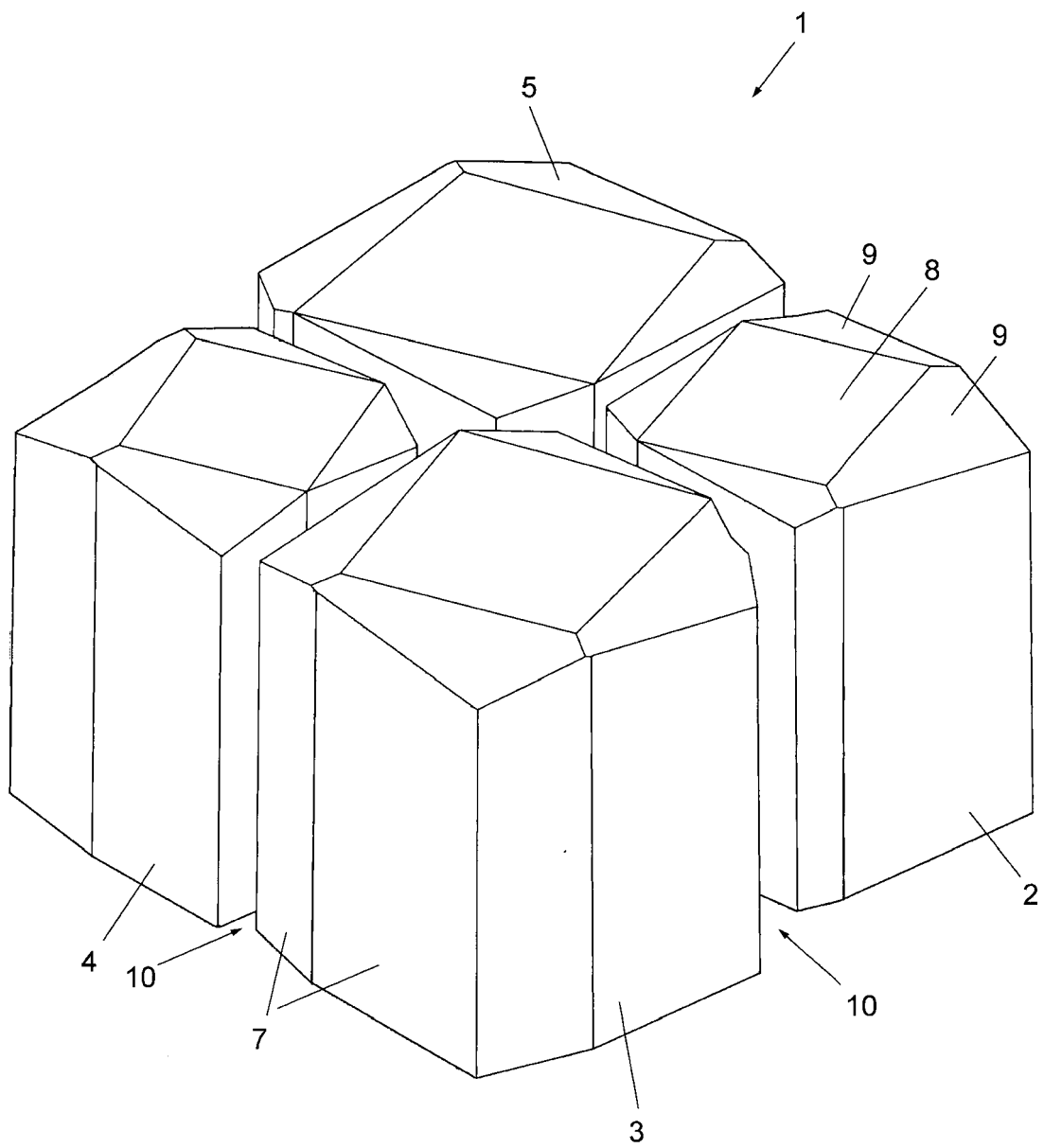


Fig. 1

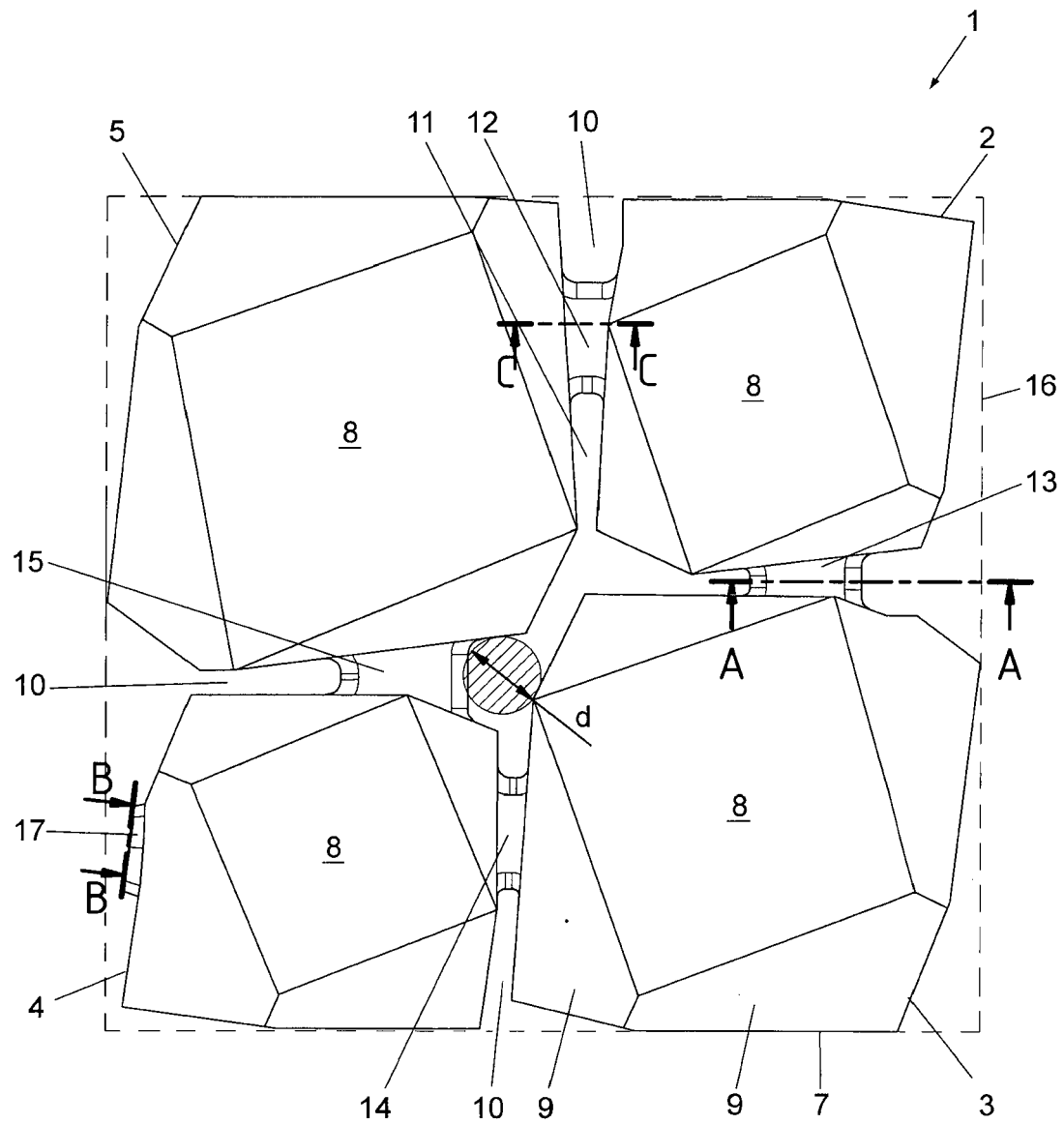


Fig. 2

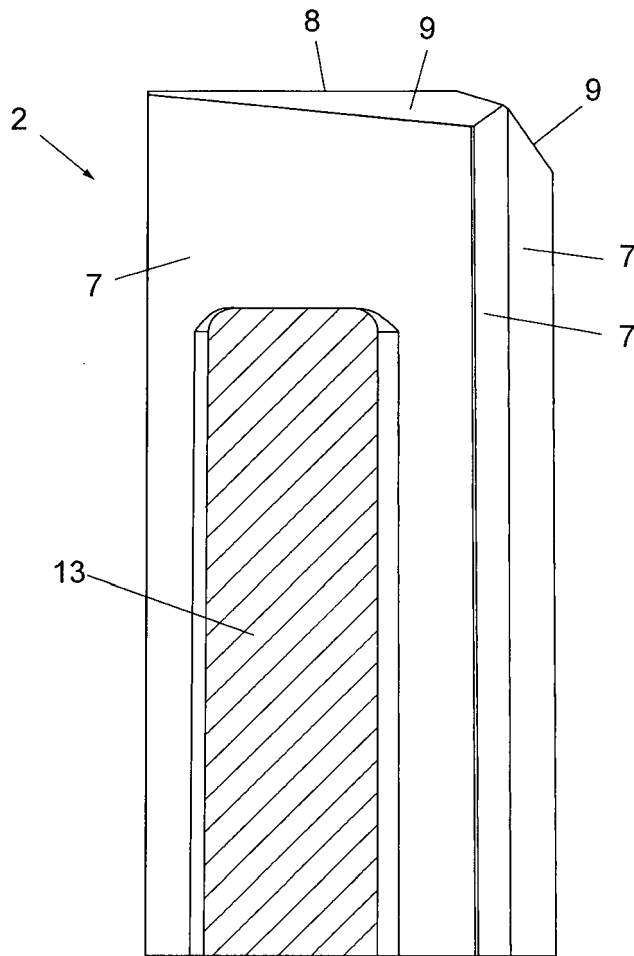


Fig. 3

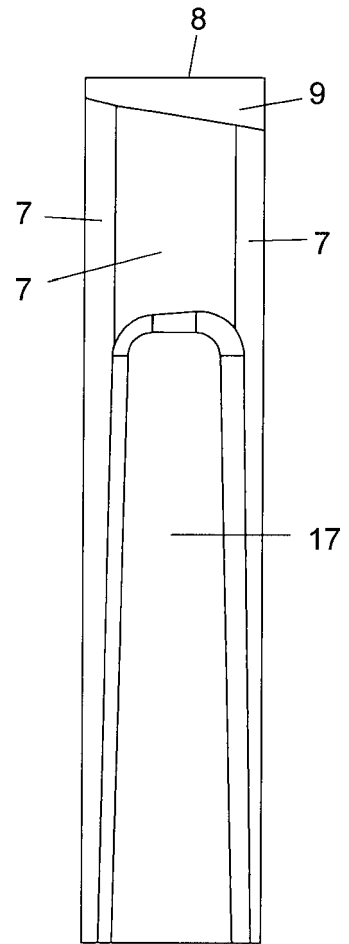


Fig. 4

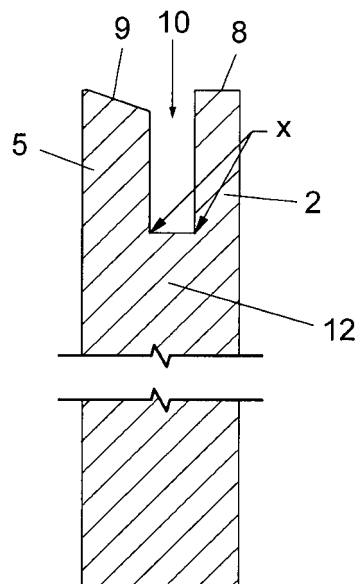


Fig. 5

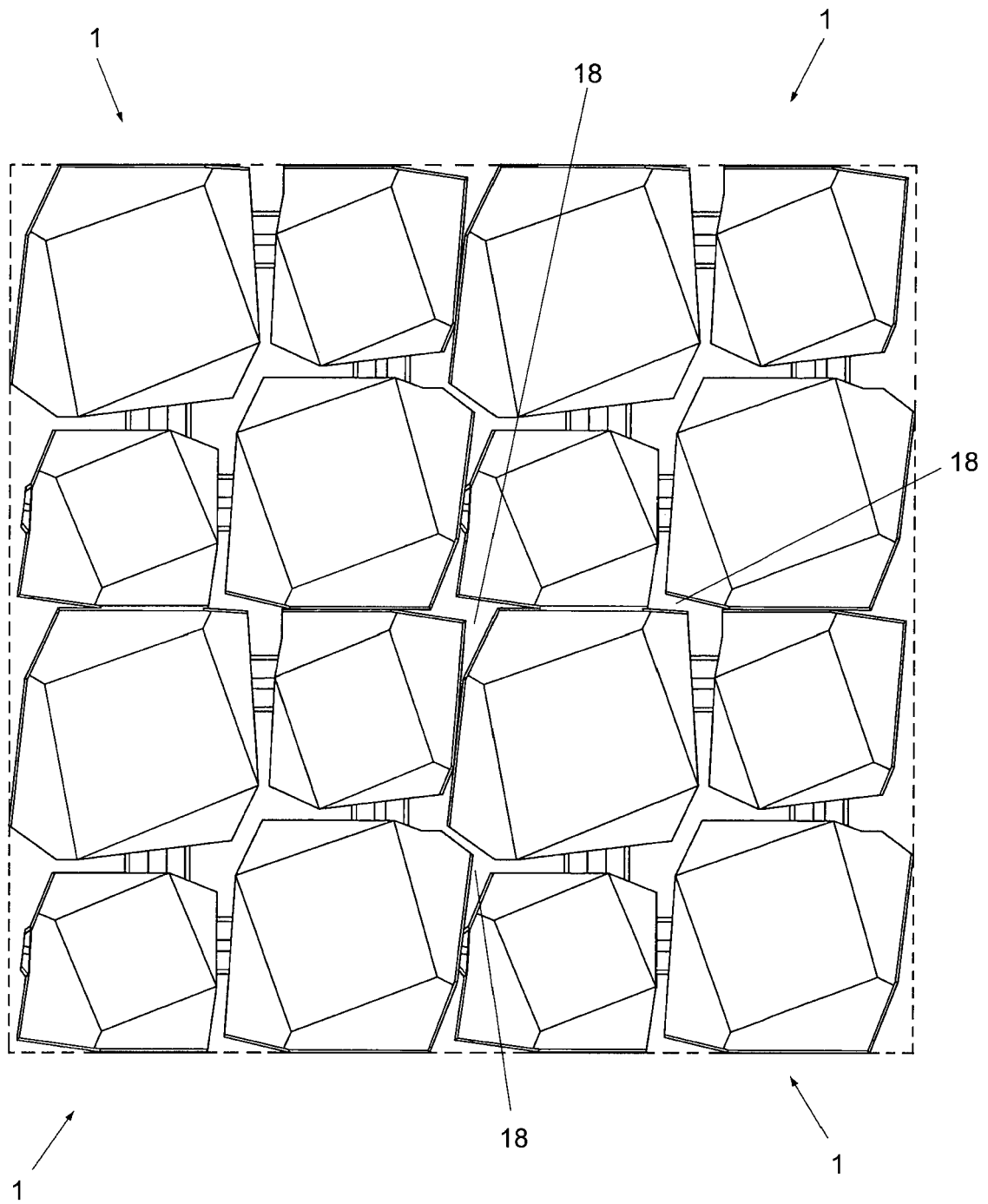


Fig. 6

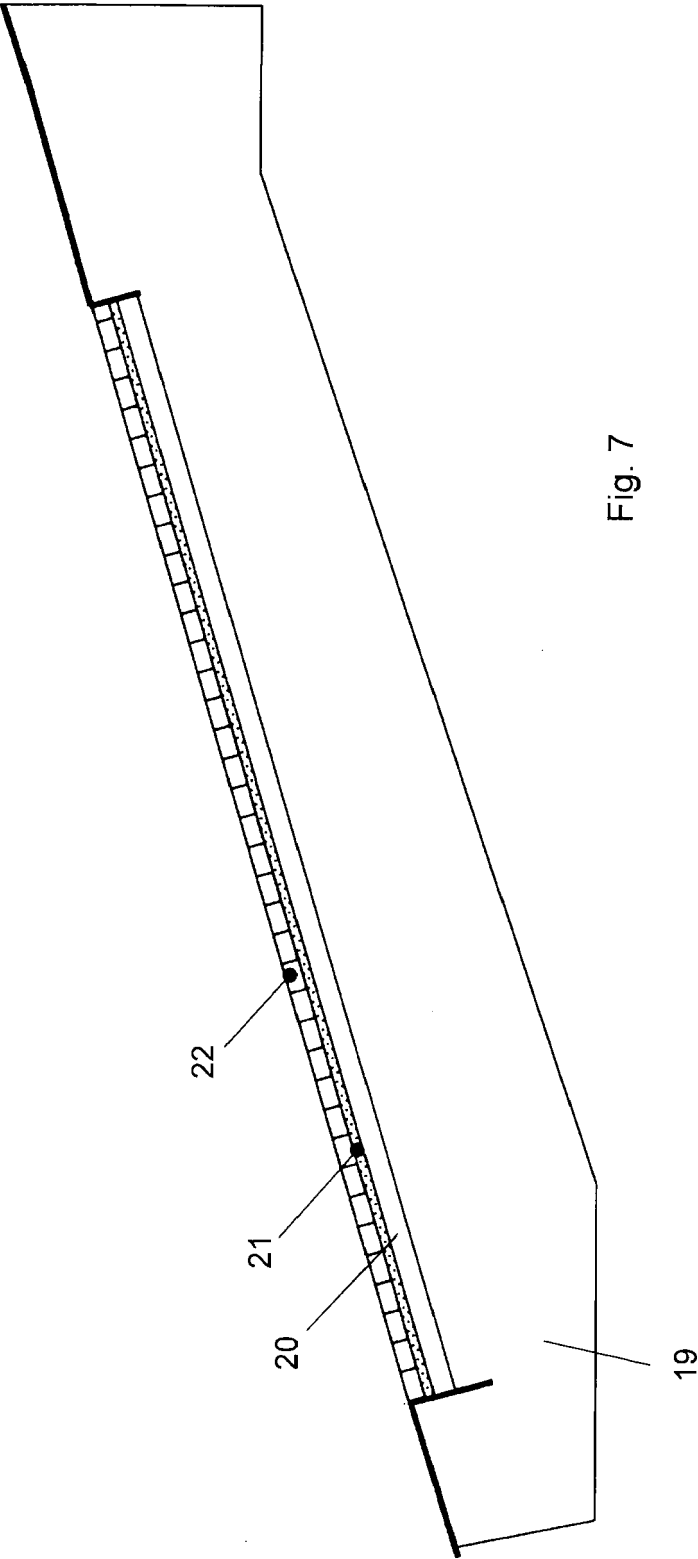


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 18 00 0784

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 015 426 A1 (BARTH GMBH DR [DE]; LANGSDORFF BAU [DE]) 17 September 1980 (1980-09-17)	1-7, 9-11, 16-21	INV. E02B3/14
Y	* page 11, paragraph 4 - page 19, paragraph 3; figures *	8,12-15	
Y	DE 26 11 764 A1 (NEDERLANDEN STAAT) 30 September 1976 (1976-09-30) * page 4, paragraph 1 - paragraph 2; figures 1-3 *	8,12-15	
A	US 3 557 669 A (FENTON MATTHEW ROBERT) 26 January 1971 (1971-01-26) * figures *	1-21	
			TECHNICAL FIELDS SEARCHED (IPC)
			E02B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 March 2019	Examiner De Coene, Petrus
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 00 0784

5 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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-03-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0015426 A1	17-09-1980	AU 535252 B2	08-03-1984
		BR 8000932 A	29-10-1980
		CA 1150553 A	26-07-1983
		DE 2905796 A1	28-08-1980
		DK 64880 A	16-08-1980
		EP 0015426 A1	17-09-1980
		ES 260645 U	01-04-1982
		JP S6337203 B2	25-07-1988
		JP S55148801 A	19-11-1980
		NO 800401 A	18-08-1980
		US 4354773 A	19-10-1982
		ZA 8000841 B	25-02-1981
DE 2611764 A1	30-09-1976	DE 2611764 A1	30-09-1976
		DE 7608571 U1	14-10-1976
US 3557669 A	26-01-1971	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2011096795 A2 [0004]