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(71) Applicant: **Freyssinet**
78140 Velizy Villacoublay (FR)

(72) Inventors:
- **Suk, Alexander**
  4824 BN Breda (NL)
- **Van Den Berg, Martin**
  3245 MB Sommelsdijk (NL)

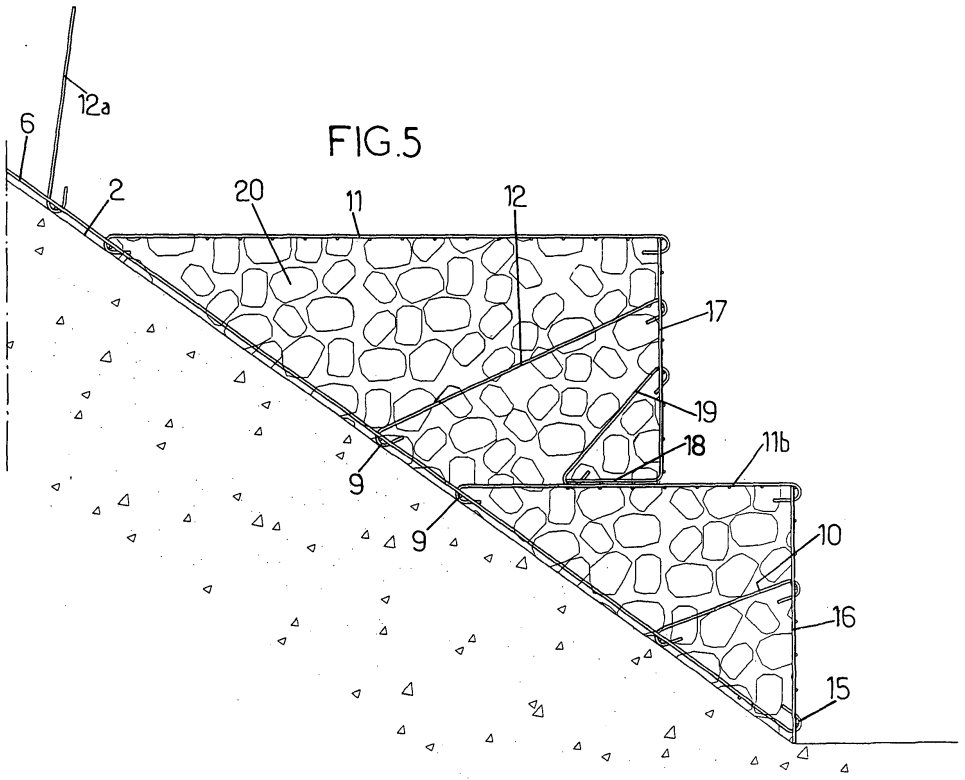
(74) Representative: **Loisel, Bertrand**
Cabinet Plasseraud
65/67 rue de la Victoire
75440 Paris Cedex 09 (FR)

Remarks:
Amended claims in accordance with Rule 86 (2) EPC.

(54) Method of constructing a stepped facing structure, and construction work thus obtained

(57) For constructing a stepped facing structure over a foundation base having a sloped surface (2), support members (6) are attached to the base. The support members extend parallel to the sloped surface and define anchoring locations spaced along the upward direction of the sloped surface. For at least one step of the facing structure, a facing panel (16-17) is erected and held by at least one link member (10-12) having a rear end hooked at one of the anchoring locations and a front end connected to a raised portion of the facing panel. A fill material (20) is introduced between the sloped surface and the facing panel.

FIG.5



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Description

[0001] The present invention relates to the construction of facing structures for civil engineering works.

[0002] It is particularly applicable to facings consisting of wire mesh panels, with stones retained and left apparent by the wire mesh panels. This type of facing is appreciated because of its relatively light weight and of its aesthetics. It can also be adapted to allow the growth of vegetation on the facing.

[0003] This sort of wire mesh facing is applicable to retaining walls. A fill made of earth, sand, rocks or another granular material is stabilized by reinforcements which extend within the fill volume. Some of the reinforcements are connected to the facing which prevents the fill material from falling apart.

[0004] Examples of such retaining walls are disclosed in GB-A-2 212 532, EP-A-0 872 597 and EP-B-0 894 169.

[0005] It is sometimes required to build the wire mesh facing structures with a stepped layout, in particular for aesthetic reasons. Plants can be grown on some of the terraces formed between the adjacent steps.

[0006] In certain cases, the stepped facing is used to cover a pre-existing, self-supporting foundation base, rather than stabilized soil which has to be retained by the facing. In such a case, it is generally not possible to connect the facing elements to reinforcements extending into the underlying base.

[0007] An object of the present invention is to overcome that difficulty.

[0008] It is thus proposed a method of constructing a stepped facing structure over a foundation base having a sloped surface. According to the invention, the method comprises the steps of:

- attaching support members to the base, the support members extending parallel to the sloped surface and defining anchoring locations spaced along the upward direction of the sloped surface;
- for at least one step of the facing structure, installing a facing panel and at least one link member having a rear end held at one of said anchoring locations and a front end connected to a raised portion of said panel; and
- introducing a fill material between the sloped surface and the facing panel.

[0009] The support members are used to hang the stepped facing structure to the sloped base. The plurality of anchoring locations allow a distribution of the load along the slope. They can also be used to transport materials up or down during the construction work. The support members can be in the form of ladders applied against the foundation base and attached by means of bolts or other types of connectors.

[0010] The method makes it possible to easily erect a stepped facing wall even where the sloped underlying surface is hard and smooth.

[0011] In a preferred embodiment, the construction of a step of the facing structure comprises:

- installing a facing panel and a first link member having a rear end held at a first one of said anchoring locations, higher than a lower edge of said facing panel, and a front end connected to a raised portion of said facing panel;
- introducing the fill material between the sloped surface and said facing panel; and
- installing a second link member having a rear end held at a second one of said anchoring locations, higher than said first anchoring locations, and a front end connected to an upper edge of said panel.

[0012] Another aspect of the present invention relates to a construction work having a stepped facing structure built over a foundation base having a sloped surface. The facing structure comprises support members attached to the base, extending parallel to the sloped surface and defining anchoring locations spaced along the upward direction of the sloped surface, and a plurality of steps arranged along the sloped surface. At least one of the steps comprises a facing panel, at least one link member having a rear end held at one of said anchoring locations and a front end connected to a raised portion of the facing panel, and fill material between the sloped surface and the facing panel.

[0013] Other features and advantages of the invention will become apparent from the following description of non-limiting exemplary embodiments, with reference to the appended drawings, in which:

- figure 1 is a schematic cross-section view of a construction work according to the invention;
- figure 2 is an lateral view of a support member mounted on the sloped foundation base;
- figure 3 is a plan view of a ladder-shaped support member; and
- figures 4-6 are lateral views illustrating various stages of a construction method according to the invention.

[0014] Figure 1 shows a construction work which can be erected in accordance with the invention.

[0015] The base to be covered is not made of stabilized soil or the like, but consists of a hard concrete foundation 1. The foundation base 1 has a sloped upper surface 2 to be covered by a facing made of stones and wire mesh panels.

[0016] The facing has a stepped configuration, which gives a special appearance to the overall structure. It also provides horizontal terraces 3 along the facing, where trees or other plants 4 can be grown for ornamental purposes. Recesses 5 are provided in the stone fill on

such terraces 3 for receiving earth or soil material enabling plants to be grown.

[0017] To build the facing, the first step consists in attaching support members 6 to the foundation base 1 (figure 2). The attachment can be made by means of bolts 7 distributed on the surface 2 of the base. The quantity and dimensions of the bolts are calculated to withstand the weight of the facing once completed.

[0018] The support members 6 applied against the base surface 2 define a number of anchoring locations that will be used to position and hold the facing elements.

[0019] In the preferred embodiment shown in figure 3, the support members 6 are in the form of ladders. Each has a pair of uprights 8 and a series of transverse rods 9 fixed to the two uprights 8. Each ladder-shaped member is positioned on the base 1 with its uprights 8 laid along the upward direction of the sloped surface 2, so as to cover substantially the whole height of the base. Hence, the transverse rods 9 define the anchoring locations spaced along the upward direction of the sloped surface. Ladder members 6 are placed parallel to each other along the horizontal direction, with a typical mutual spacing of one or a few meters.

[0020] While the construction of the stepped wall takes place, the ladder-shaped support members 6 are usable to transport loads up or down the sloped surface.

[0021] Some of the transverse rods 9 of a support member 6 receive hooked ends of connecting members 10, 11 a, 12a which can be put in place as soon as the support member 6 has been attached to the sloped surface 2, as shown in figure 2, or later.

[0022] The lower ends of the ladder uprights 8 are bent in the form of hooks 15 (figure 2). The hooks 5 receive the lower edge of the lower wire mesh facing panel 16, as shown in figure 4.

[0023] When installing the lower facing panel 16, the lowest connecting member 10 hanged to the ladder rods 9 is lifted and its end remote from the rod 9, which is also bent, is hooked around one of the wires of the raised mesh panel 16. The connecting member 10 thus forms an elongated link which holds the wire mesh panel 16 in a vertical position as the stone fill 20 is poured between the panel 16 and the sloped surface 2. Wire mesh partitions (not shown) are arranged parallel to the plane of figures 4-6 to delimit laterally the volume receiving the stone fill 20.

[0024] Once the fill 20 has been introduced up to the level of the upper edge of the wire mesh panel 16, the first step of the facing is completed by positioning another wire mesh panel 11 b horizontally over the upper level of the fill. In the example, the front end of the panel 11 b is bent in order to hook around the upper edge of the vertical panel. The panel 11 b is lowered as indicated by the arrow in figure 4. Connecting members 11 a hanged to the ladder rods 9 are then pivoted down and welded to the wire mesh panel 11 b. This closes the volume of the lower step and provides another link 11 (=11a+11b) for securing the panel 16 to the support members 6. The cover panel 11 b is made from high tensile strength wire mesh in order to create a stable base for the next row of facing panels.

[0025] In the example depicted in figure 5, the second step of the facing has a vertical front panel 17 which belongs to an L-shaped wire mesh element which also has a base portion 18 folded perpendicularly to be laid on the upper side 11 b of the underlying step. A stiffener link 19 is connected to the base portion 18 and the front panel 17 to maintain the 90° angle between them.

[0026] Once the L-shaped wire mesh element 17-18 has been put in place, the next connecting member 12a is lowered and another connecting member is installed with a hooked-end gripping the wire mesh of the raised panel 17 and an opposite end joined to the free end of the connecting member 12a. These two connecting members are then welded together to form an elongated link 12 having the suitable length as shown in figure 5. Several such links 12 are made along the structure, and lateral partitions (not shown) are installed. At this time the stone fill of the second step can be introduced. Once the appropriate fill level is reached, the upper panel 11 of the step can be brought, assembled and fixed as described with reference to figure 4.

[0027] The connections at the bottom and in the middle of each facing panel 16, 17 stabilizes it during the installation of the stones. The additional cover connection 11 at the top of the facing panel minimizes the deformation of the structure while the next step is being built.

[0028] The above-described process of erecting a facing step can be iterated up to the upper level of the wall.

[0029] If required, intermediate steps 21 can be added between the thus formed main steps as shown in figure 1. Such intermediate steps 21 can be made by assembling wire mesh panels in the corners between adjacent steps, or by installing prefabricated wire mesh boxes (gabions). In an embodiment of the invention, such intermediate steps 21 have a reduced length perpendicularly to the plane of figure 1 (e.g. between 1 and 2 meters), and are used to provide stairs for allowing maintenance personnel to easily climb up or down the structure.

[0030] A remarkable feature of the above-described process of erecting the facing steps is that it is very easy to modulate the width of the terraces 3 between adjacent steps. Such terrace width modulation can be required by the architect. It suffices that the links 11, 12 held at anchoring locations at a common vertical level have a variable length along the work, i.e. in the direction perpendicular to the plane of figures 4-6.

[0031] More generally, the process is very flexible regarding the position of the individual steps. The width of the terraces can be varied at will to accommodate the wishes of the architect of the structure. The facing panel 17 is designed so that it can be put in place in various positions on top of the underlying cover element 11 b.

[0032] The steps, or only some of them, can easily be made of a curved or rounded shaped if desired, which is very difficult, if possible, to achieve with conventional fac-

ings or with gabions.

[0033] Figure 6 illustrates how a recess 5 filled with soil material 25 can be provided on a terrace 3 between two adjacent steps. The step where the recess is made is prepared as indicated previously, by installing the L-shaped wire mesh element comprising the front panel 17, assembling elongated links 12, and pouring stones 20.

[0034] The fill is introduced up to the top of the step, leaving a ditch to form recess 5. At this time, a wire mesh edge element 26 is hooked to the upper edge of the front panel 17. The edge element 26 has a bent shape as shown in the cross-sectional view of figure 6, so that its front part defines the edge of the terrace 3 and is bent rear part forms the front wall of the recess 5. Then, the L-shaped wire mesh element 17-18 for the next step, with its stiffeners 19, is laid on the current upper level of the fill, whereby the bottom of the next facing panel 17 defines the rear wall of the recess 5. Additional stones are introduced to maintain the new L-shaped element 17-18 in place. It is possible to fold back one or more of the next connecting members 12a and to assemble them to form elongated links for holding the next facing panel 17 while more stones are introduced.

[0035] A geotextile liner 27 is placed into the recess 5 before it is filled with the soil material 25. The liner 27 separates the soil material 25 from the stones 20. It prevents the soil material from leaking through the stones while allowing the flow of water.

Claims

1. A method of constructing a stepped facing structure over a foundation base (1) having a sloped surface (2), the method comprising the steps of:

- attaching support members (6) to the base, the support members extending parallel to the sloped surface and defining anchoring locations spaced along the upward direction of the sloped surface;
- for at least one step of the facing structure, installing a facing panel (16-17) and at least one link member (10-12) having a rear end held at one of said anchoring locations and a front end connected to a raised portion of said panel; and
- introducing a fill material (20) between the sloped surface and the facing panel.

2. The method as claimed in claim 1, wherein the support members comprise ladder-shaped members (6) each having a pair of parallel uprights (8) laid along the upward direction of the sloped surface (2) and a series of transverse rod elements (9) each fixed to the two uprights, whereby the rod elements define the anchoring locations.

3. The method as claimed in claim 1 or 2, wherein the construction of a step of the facing structure comprises:

- installing a facing panel (16-17) and a first link member (10, 12) having a rear end held at a first one of said anchoring locations, higher than a lower edge of said facing panel, and a front end connected to a raised portion of said facing panel;
- introducing the fill material (20) between the sloped surface and said facing panel; and
- installing a second link member (11) having a rear end held at a second one of said anchoring locations, higher than said first anchoring locations, and a front end connected to an upper edge of said panel.

4. The method as claimed in any one of the preceding claims, further comprising the step of using the support members (6) to transport loads up or down the sloped surface (2) during the construction of the stepped facing structure.

5. The method as claimed in any one of the preceding claims, wherein the facing panels (16-17) comprise wire mesh panels and the fill material (20) comprises stones.

6. A construction work having a stepped facing structure built over a foundation base (1) having a sloped surface (2), wherein the facing structure comprises support members (6) attached to the base, extending parallel to the sloped surface and defining anchoring locations spaced along the upward direction of the sloped surface, and a plurality of steps arranged along the sloped surface, and wherein at least one of the steps comprises a facing panel (16, 17), at least one link member (10-12) having a rear end held at one of said anchoring locations and a front end connected to a raised portion of the facing panel, and fill material (20) between the sloped surface and the facing panel.

7. The construction work as claimed in claim 6, wherein the support members comprise ladder-shaped members (6) each having a pair of parallel uprights (8) laid along the upward direction of the sloped surface and a series of transverse rod elements (9) each fixed to the two uprights, whereby the rod elements define the anchoring locations.

8. The construction work as claimed in claim 7, wherein the uprights (8) of at least some of the ladder-shaped support members (6) have a lower end bent to form hook means (15), and wherein said hook means receive a lower edge of a facing panel (16).

9. The construction work as claimed in any one of claims 6 to 8, wherein the facing panel (17) of at least one step of the facing structure has a lower edge bearing on the upper surface of an underlying step of the facing structure.

10. The construction work as claimed in any one of claims 6 to 9, wherein the link members comprise wire mesh panels (11) each extending between an upper edge of a facing panel (16-17) and the sloped surface (2) where it is secured at an anchoring location, whereby said wire mesh panel (11) defines an upper surface of a step of the facing structure.

11. The construction work as claimed in any one of claims 6 to 10, wherein the link members comprise elongated links (10, 12) having hooked ends for connection to the support members (6) and the facing panels (16-17).

12. The construction work as claimed in any one of claims 6 to 11, wherein some of the link members (11-12) held at anchoring locations at a common vertical level have a variable length to accommodate terraces of variable width between two adjacent steps.

13. The construction work as claimed in any one of claims 6 to 12, wherein the facing panels comprise wire mesh panels (16-17) and the fill material (20) comprises stones.

14. The construction work as claimed in claim 13, wherein the fill material further comprises soil material (25) contained in at least one recess (5) formed on a terrace (3) between two adjacent steps.

15. The construction work as claimed in claim 14, further comprising a geotextile liner (27) laid in said recess (5) to separate the soil material (25) from the stones (20).

16. The construction work as claimed in any one of claims 6 to 15, further comprising intermediate steps (21) of a reduced length arranged between adjacent steps having facing panels (16, 17) connected to said anchoring locations via link members (10-12), so as to provide stairs for maintenance personnel to climb up or down the structure.

Amended claims in accordance with Rule 86(2) EPC.

1. A method of constructing a stepped facing structure over a foundation base (1) having a sloped surface (2), the method comprising the steps of:

- attaching support members (6) to the base, the support members extending parallel to the sloped surface and defining anchoring locations spaced along the upward direction of the sloped surface;
- for at least one step of the facing structure, installing a facing panel (16-17) and a first link member (10, 12) having a rear end held at a first one of said anchoring locations, higher than a lower edge of said facing panel, and a front end connected to a raised portion of said facing panel; and
- introducing a fill material (20) between the sloped surface and the facing panel; and
- installing a second link member (11) having a rear end held at a second one of said anchoring locations, higher than said first anchoring location, and a front end connected to an upper edge of said panel.

2. The method as claimed in claim 1, wherein the support members comprise ladder-shaped members (6) each having a pair of parallel uprights (8) laid along the upward direction of the sloped surface (2) and a series of transverse rod elements (9) each fixed to the two uprights, whereby the rod elements define the anchoring locations.

3. The method as claimed in any one of the preceding claims, further comprising the step of using the support members (6) to transport loads up or down the sloped surface (2) during the construction of the stepped facing structure.

4. The method as claimed in any one of the preceding claims, wherein the facing panels (16-17) comprise wire mesh panels and the fill material (20) comprises stones.

5. A construction work having a stepped facing structure built over a foundation base (1) having a sloped surface (2), wherein the facing structure comprises support members (6) attached to the base, extending parallel to the sloped surface and defining anchoring locations spaced along the upward direction of the sloped surface, and a plurality of steps arranged along the sloped surface, and wherein at least one of the steps comprises a facing panel (16, 17), a first link member (10, 12) having a rear end held at a first one of said anchoring locations, higher than a lower edge of said facing panel, and a front end connected to a raised portion of the facing panel, a second link member (11) having a rear end held at a second one of said anchoring locations, higher than said first anchoring location, and a front end connected to an upper edge of said panel, and fill material (20) between the sloped surface and the facing panel.

6. The construction work as claimed in claim 5,

wherein the support members comprise ladder-shaped members (6) each having a pair of parallel uprights (8) laid along the upward direction of the sloped surface and a series of transverse rod elements (9) each fixed to the two uprights, whereby the rod elements define the anchoring locations.

7. The construction work as claimed in claim 6, wherein the uprights (8) of at least some of the ladder-shaped support members (6) have a lower end bent to form hook means (15), and wherein said hook means receive a lower edge of a facing panel (16).

8. The construction work as claimed in any one of claims 5 to 7, wherein the facing panel (17) of at least one step of the facing structure has a lower edge bearing on the upper surface of an underlying step of the facing structure.

9. The construction work as claimed in any one of claims 5 to 8, wherein the link members comprise wire mesh panels (11) each extending between an upper edge of a facing panel (16-17) and the sloped surface (2) where it is secured at an anchoring location, whereby said wire mesh panel (11) defines an upper surface of a step of the facing structure.

10. The construction work as claimed in any one of claims 5 to 9, wherein the link members comprise elongated links (10, 12) having hooked ends for connection to the support members (6) and the facing panels (16-17).

11. The construction work as claimed in any one of claims 5 to 10, wherein some of the link members (11-12) held at anchoring locations at a common vertical level have a variable length to accommodate terraces of variable width between two adjacent steps.

12. The construction work as claimed in any one of claims 5 to 11, wherein the facing panels comprise wire mesh panels (16-17) and the fill material (20) comprises stones.

13. The construction work as claimed in claim 12, wherein the fill material further comprises soil material (25) contained in at least one recess (5) formed on a terrace (3) between two adjacent steps.

14. The construction work as claimed in claim 13, further comprising a geotextile liner (27) laid in said recess (5) to separate the soil material (25) from the stones (20).

15. The construction work as claimed in any one of claims 5 to 14, further comprising intermediate steps (21) of a reduced length arranged between adjacent steps having facing panels (16, 17) connected to said anchoring locations via link members (10-12), so as to provide stairs for maintenance personnel to climb up or down the structure.

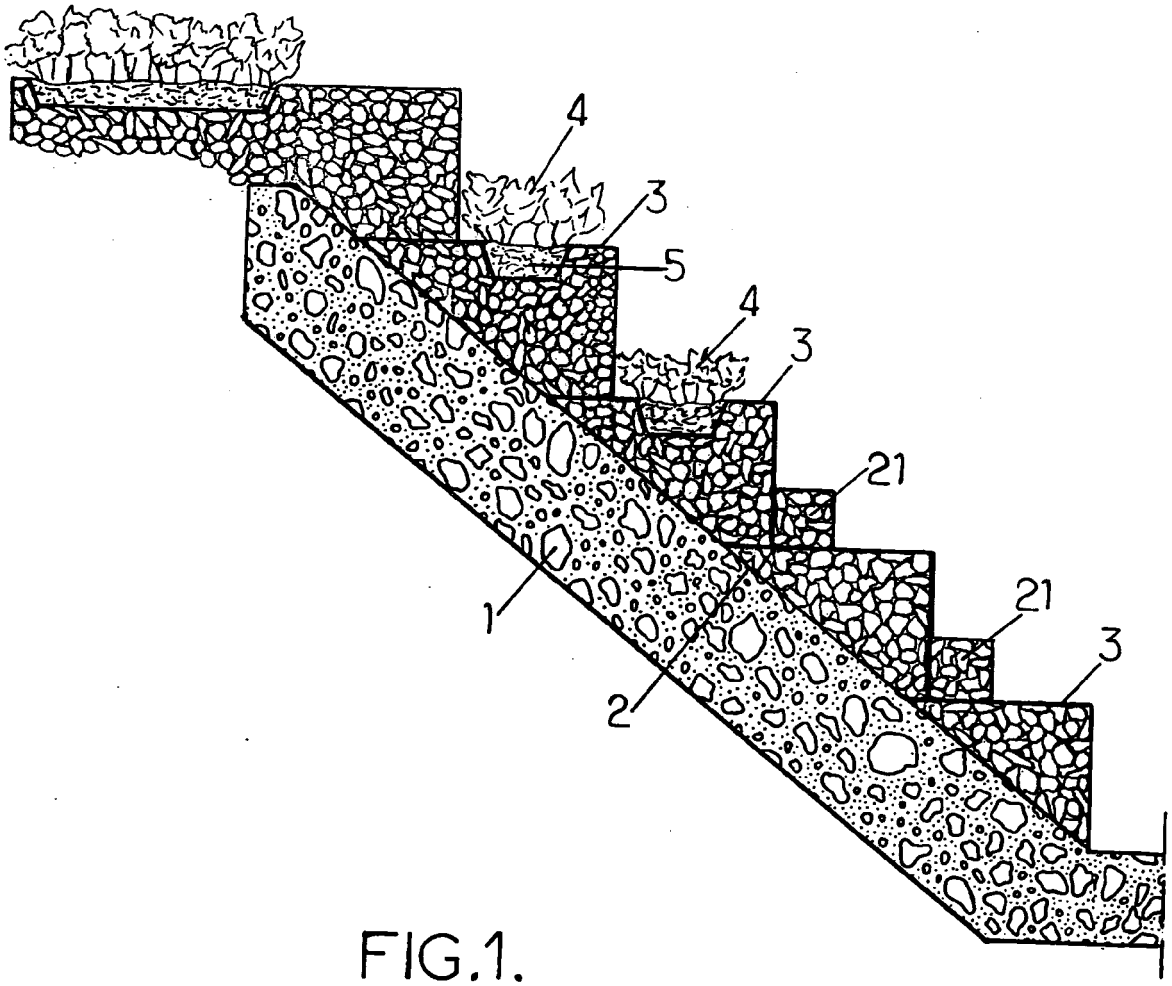


FIG.1.

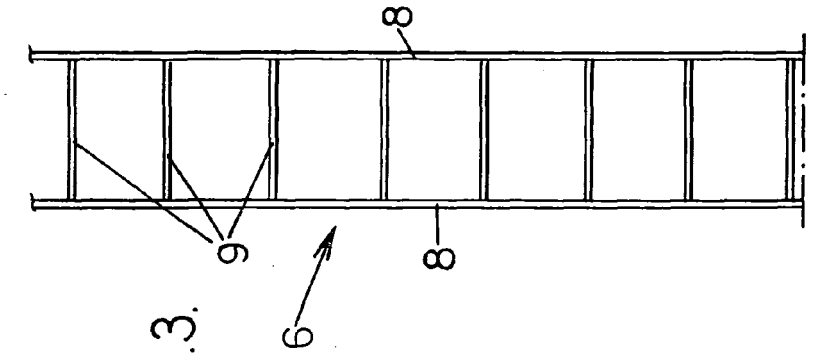


FIG.3.

FIG.2.

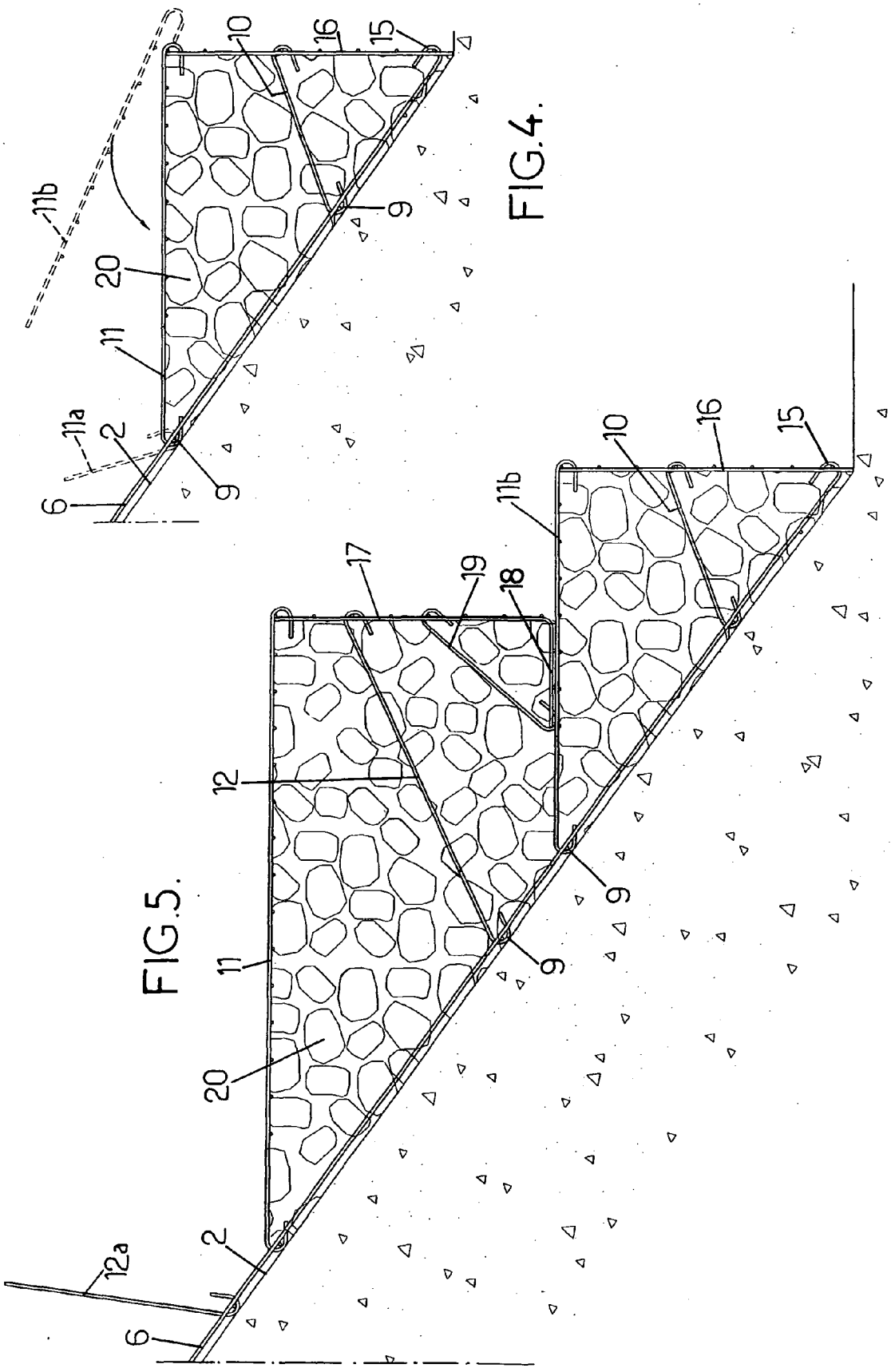
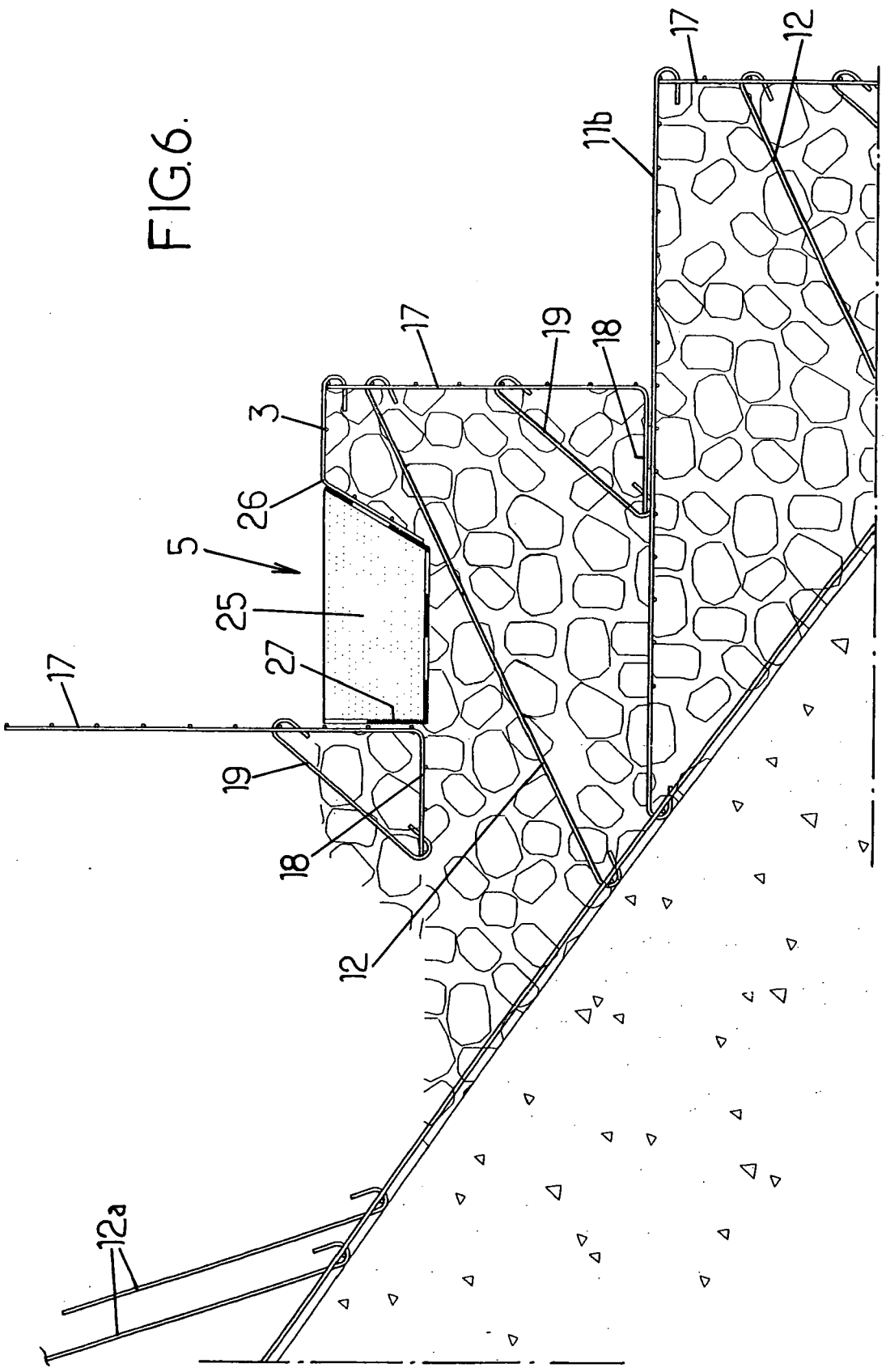


FIG.4.

FIG.5.

FIG.6.



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EUROPEAN SEARCH REPORT

Application Number
EP 05 29 0598

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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A	WO 96/04430 A (STEINER, PETER) 15 February 1996 (1996-02-15) * figure 1 * -----	1-16	
A	WO 96/17134 A (PHI GROUP LIMITED; BIGG, KENNETH, CHARLES; PRICE, IAN, RICHARD) 6 June 1996 (1996-06-06) * figure 4 * -----	1-16	TECHNICAL FIELDS SEARCHED (Int.Cl.7) E02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 September 2005	Nilsson, L

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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1

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