

- [54] **SYSTEM OF ARMOURING EARTH**
- [75] Inventors: **Bengt Broms**, Vallingby; **Oleg Wager**, Bromma, both of Sweden
- [73] Assignee: **AB Fodervavnader**, Boras, Sweden
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- [58] **Field of Search** 61/35, 37, 38, 39, 49; 404/31

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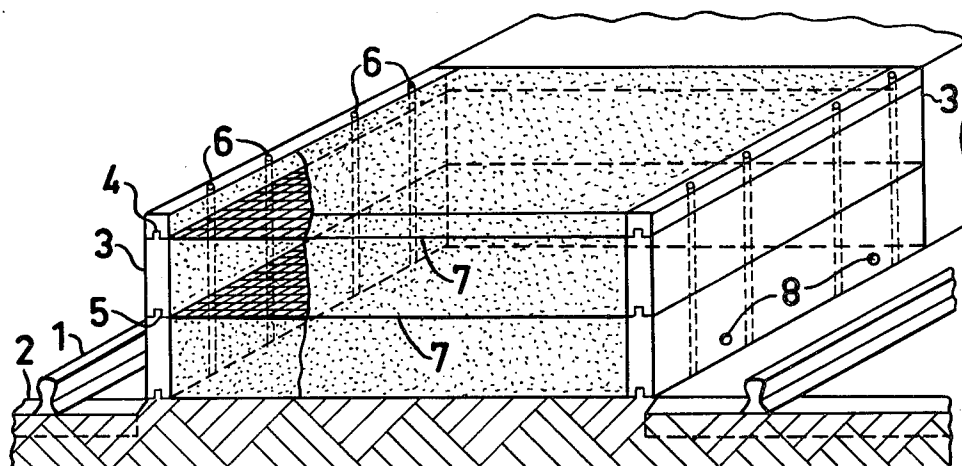
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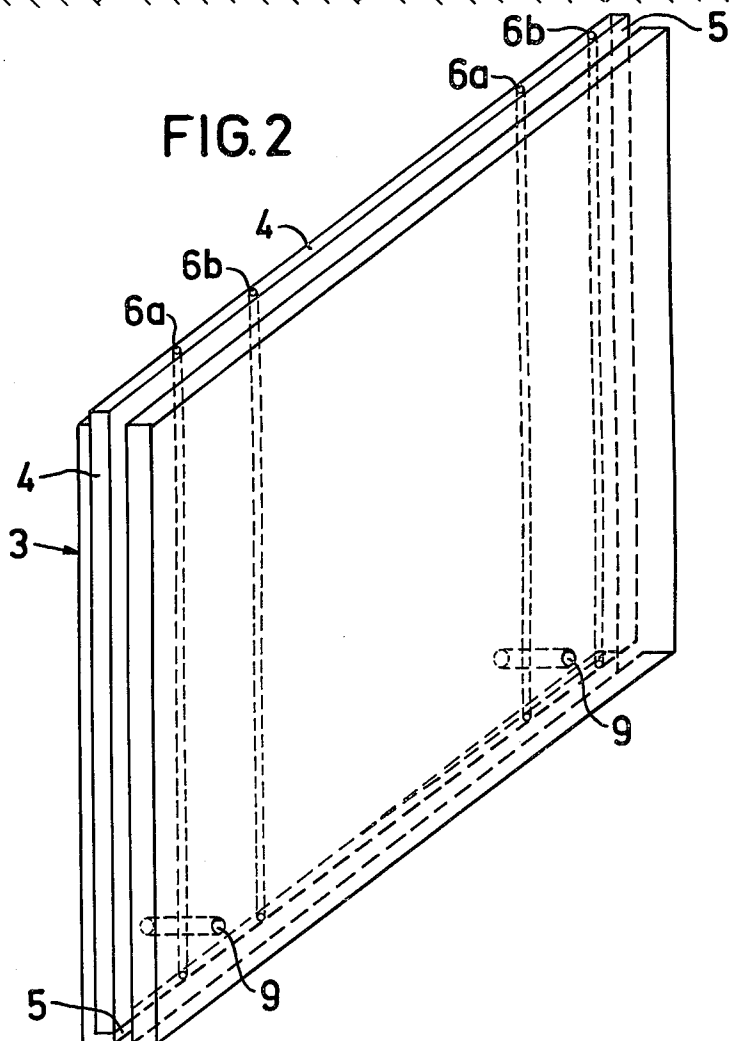
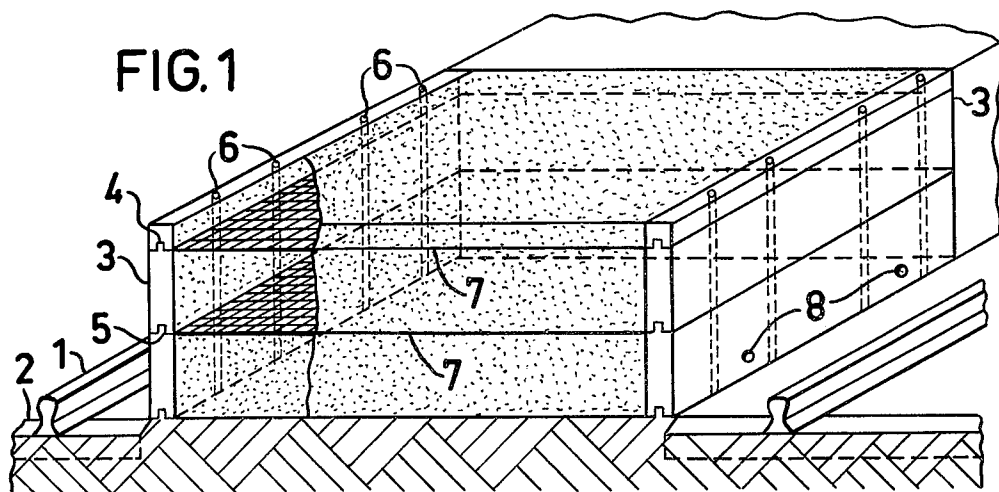
Primary Examiner—Casmir A. Nunberg
Assistant Examiner—David H. Corbin
Attorney, Agent, or Firm—Elliott I. Pollock

[57] ABSTRACT

An earth-filling reinforcement structure comprises one or more elongated, earth-imbedded carpets oriented in a plane substantially parallel to the surface of the earth being reinforced. Each carpet comprises a comparatively wide net-like sheet fabricated of a substantially non-corrosive metallic or synthetic material, with the opposing ends of each sheet being rigidly anchored between a pair of beam elements fabricated of concrete or the like.

10 Claims, 7 Drawing Figures





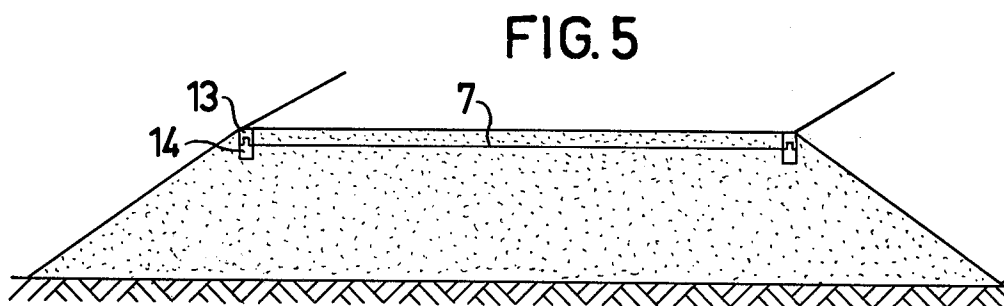
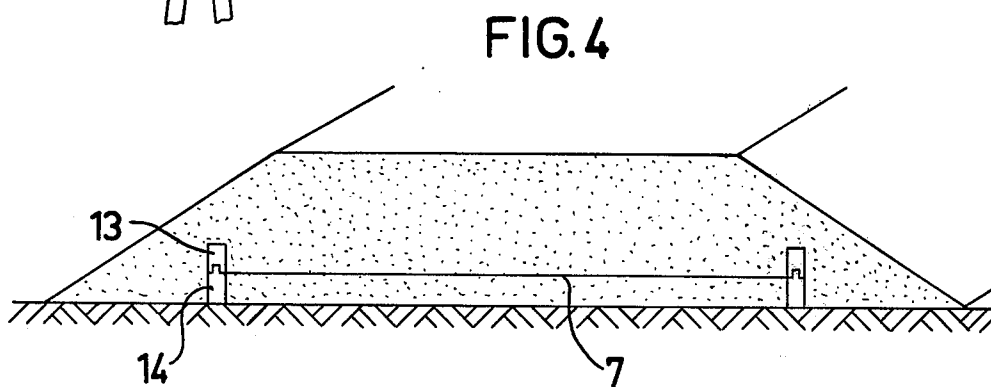
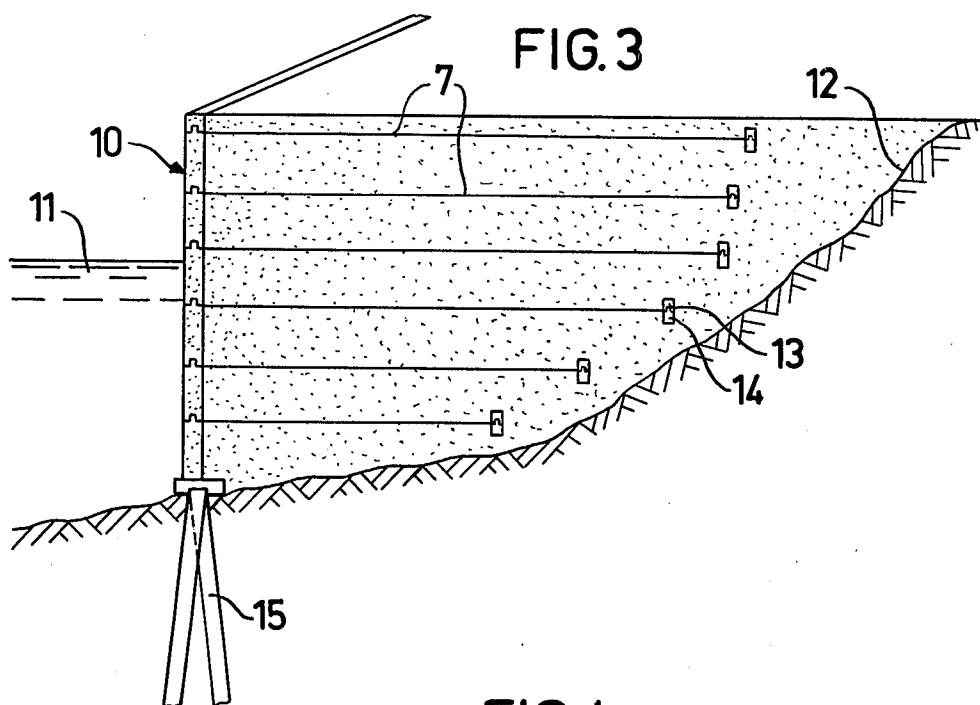


FIG. 6

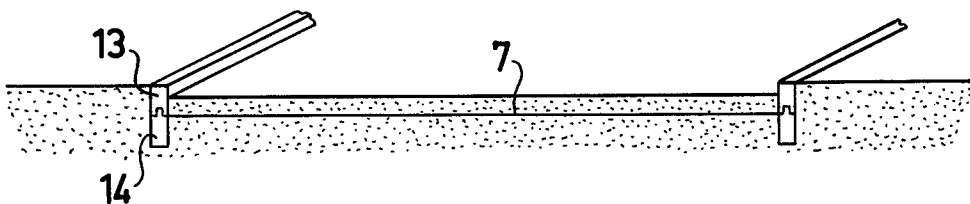
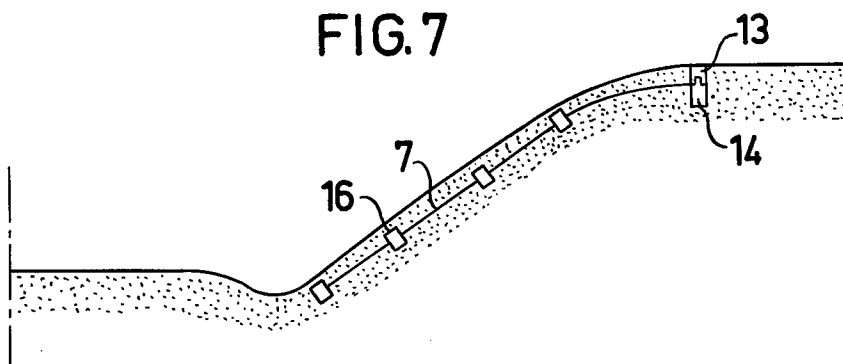


FIG. 7



SYSTEM OF ARMOURING EARTH

The present invention refers to a system for armouring of earth by means of at least one net-like sheet or "carpet" fabricated of a non-corrosive metal or a synthetic material, oriented in a plane substantially parallel with the level of the earth.

Armouring systems of the above general kind have to a steadily increasing degree (especially in France and Japan) replaced the conventional expensive, as well as clumsy and heavy steel armourings — mostly in the form of pulling or anchoring bars — for guarding against earth slides and slips accidentally occurring in earth filling structures for various purposes.

However, the previously known and applied armouring structures for earth by means of carpets have not been able to appropriately meet the requirements of efficiency, and they have been restricted to relatively limited application fields.

A more universal use of application, combined with an improved armouring ability, is attained by the present invention by the fact that the carpet is, at both ends, rigidly anchored in a beam member of concrete or the like, said beam member consisting of two beam elements, one on top of the other and fixing between themselves an end of said carpet length, and — if required — supplemented with a clamping bond for pressing the beam elements against each other.

The structure of the invention can be used for stabilizing bank fillings on a weak underground support, for reducing the earth pressure against walls of brick, stones or the like, as well as for the actual building-up of such walls, quays, platforms etc.; further, the invention can advantageously be used for locking kerbstones during the building of streets with pavements, for stabilizing road banks and for stabilizing slopes in banks and intersections.

Further details of the invention will be described below with reference to the accompanying drawings, wherein

FIG. 1 shows a schematic isometric view of a portion of a platform or a wharf;

FIG. 2, drawn on a larger scale, shows an element or a module in the structure according to FIG. 1;

FIG. 3 shows, in a sectional view, a schematic isometric picture of a quay (or a wall);

FIGS. 4, 5 and 6 show, in sections, a view of a first and a second bank filling, and a street with a pavement, respectively; and

FIG. 7 shows, in section, a view of a slope.

The platform or the wharf shown in FIG. 1 has rails and sleepers indicated at 1 and 2, respectively, on each side of the structure. In the example chosen, the structure comprises walls of preformed, preferably from concrete, plate shaped elements 3, piled or stacked one over the other. The elements are maintained in place vertically and laterally by, on one hand, engaging members in the form of ribs 4 on the upper edge surfaces and associated first side edges (FIG. 2) of each element, and corresponding grooves 5 on the under edge surfaces and the associated second side edges, and on the other hand, by round iron bars which are pushed through vertical channels 6 in each element, as indicated in FIG. 1.

Between the horizontal engagement means of the elements in each of the two parallel walls the respective ends of carpets 7 fabricated of a non-corrosive mate-

rial, preferably of a synthetic fibre woven fabric, are firmly clamped. The figure shows two such carpets which delimit three layers of earth. Due to the firm anchoring of the carpets 7 between the concrete elements, 3 each of such elements (of the two undermost in FIG. 1) is subjected to only the pressure applied by each separate layer of earth instead of a downwardly accumulating pressure throughout the whole depth of the earth, as hitherto has been the case and thus required a downwardly increasing thickness of the wall structure. Thus, the elements 3 may, on one hand, be manufactured with a uniform thickness and, on the other hand, be made surprisingly thin.

The figure also shows a pair of drain holes 8.

FIG. 2 shows in more detail an example of a concrete element 3 having ribs 4 on its upper and one side edge and grooves 5 in its under and second side edge. The four channels 6 schematically indicated in FIG. 1 are also present in FIG. 2, pairwise designated 6a and 6b. The purpose of the channels is to facilitate the assembling and the vertical alignment of elements 3 when building the wall. Thus, first the lowest elements are laterally engaged with each other, and over these elements an additional row of elements are positioned, whereafter guiding round irons are inserted in the channels 6a and 6b. Before the positioning of the second row of elements, however, a first set of carpets (preferably of the same width as the elements) are placed with their ends resting on the upper edges of the elements. Before the positioning of the third row of elements another set of carpets is applied etc. It is, of course, understood that earth filling (marked by small dots) is alternately supplied with the carpets.

The thin and therefore relatively light concrete elements in conjunction with the guiding method described above facilitates greatly the building-up which may be performed rapidly as well as exactly contrary to the known techniques where heavy walls have to be cast at the building site after a labourous preparing of supporting form structures and could not be used until after an adequate hardening.

In their lower part the elements are provided with drain holes 9.

In the quay or wall structure shown in FIG. 3 the actual (brick) wall 10 corresponds completely to the left wall in FIG. 1. Particularly obvious from this figure is the uniform thinness of the wall enabled by the concept on which the invention is based. To the left of the quay wall there is shown water 11, and at the right side a fairly steep slope 12. Thus, as no wall exists to the right, the right ends of the carpets 7 must be fixed in another way, namely by clamping right the end edge of each carpet between two (concrete) beams 13 and 14. The anchoring between the beams may be secured by means of engaging means in the same manner as with the wall 10 and/or by bolt joints or the like. The wall is shown founded on piles 15.

An armouring arrangement by means of two pairs of concrete beams 13 and 14 and an intermediate carpet 7 is shown in FIG. 4 for a bank filling on a weak underground support, for a stabilizing of a bank crest in FIG. 5, and for a street with a pavement in FIG. 6.

In FIG. 7, finally, there is shown a stabilizing of a slope, where a carpet 7 is anchored in the bank crest by means of the beam element pair 13, 14 and laid along the slope and, if required, — i.e. if the slope is steep and therefore the length of the carpet is too short for accumulating a sufficiently strong friction — maintained in

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place along the slope by means of thinner beam pairs 16, spaced at geotechnically adequate distances from each other.

Summing up, the invention makes it possible to use preformed, material-saving element modules which are easily transportable and easy to handle so as to enable a rapid and economic building of platform and quay structures as well as stabilizing of slopes, road borders and slope crests on causeways etc.

The invention is not restricted to the embodiments described above but various modifications are possible within the scope of the invention, especially by replacing the specified details by means of an equivalent nature. Thus, the cooperating engaging means of the elements — not necessarily made of concrete — may be varied in a multitude of ways, and the round irons extending through channels in the elements for effecting the straightening-up may be replaced by fixed guide pins for inserting in corresponding holes in the adjacent element. As to the carpets, they may — instead of synthetic fiber (woven polyester) — consist of a non-corrosive metal net; as a general rule the carpet material should have a relatively high coefficient of elasticity and a substantially negligible creeping during load. As in most cases it is considered that the carpets represent the larger part of the total costs for the combination elements/carpets, one may — if allowed by the geotechnical conditions — reduce the total costs by, in the vertical direction, omitting carpets in certain element joints. Instead of clamping the ends of the carpets between the associated pair of elements, the carpets could be made continuous and arranged to form a loop around one element of the pair and return to the start point, where it again could be looped etc.

What we claim is:

1. A structure for reinforcing and anchoring a body of earth, comprising at least one comparatively wide, elongated, substantially continuous sheet of reinforcing material imbedded within said body of earth and oriented in a plane spaced from and substantially parallel to the external surface of said body of earth, said sheet having a net-like configuration throughout its length and width and being fabricated of a substantially non-corrosive material, each of the opposing comparatively wide ends of said elongated sheet being interposed and rigidly anchored between the facing edges of a pair of elongated, contiguous, superposed beam elements extending respectively in directions substantially parallel to the plane of said sheet.

2. The structure of claim 1 including means extending between said superposed beam elements in a direc-

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tion transverse to the plane of said sheet for forcibly pressing the facing edges of said superposed beam elements against one another.

3. The structure of claim 1 wherein the facing edges of said superposed beam elements have complementary non-planar configurations which interengage one another though the end of said elongated sheet interposed therebetween.

4. The structure of claim 3 wherein said complementary non-planar configurations comprise at least one outwardly protruding rib extending in the direction of elongation of one of said beam elements, and an elongated complementary groove extending in the direction of elongation of the other of said elements for receiving said rib.

5. The structure of claim 4 wherein the opposing side edges of each beam element, extending in directions generally perpendicular to the plane of said sheet, are provided respectively with an outstanding elongated rib and with a complementarily shaped elongated groove to permit plural such beam elements to be assembled in interengaged relation to one another in a direction generally parallel to the plane of said sheet.

6. The structure of claim 4 wherein the upper and lower edge of each of said beam elements is provided with at least one of said ribs and with at least one of said grooves respectively, a plurality of said beam elements being disposed in superposed stacked configuration to form a substantially solid wall, and a plurality of said sheets extending in generally parallel spaced relation to one another in directions transverse to the plane of said wall, the corresponding ends of each of said sheets being rigidly anchored between the facing edges of different superposed pairs of said beam elements at different vertical levels along said wall.

7. The structure of claim 1 wherein said superposed beam elements are provided with interior, generally vertically oriented channels in alignment with one another from one to the other of said beam elements, and a rod-like member extending through each of said aligned channels from one to the other of said beam elements to maintain said superposed beam elements at predetermined positions relative to one another.

8. The structure of claim 1 wherein each of said beam elements comprises a plurality of preformed members which have predetermined standard dimensions.

9. The structure of claim 1 wherein said sheet comprises a woven fabric of synthetic fiber material.

10. The structure of claim 1 wherein said sheet comprises a metallic mesh.

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