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(71) Applicant:
Kankyo Kogaku Co., Ltd.
Hino-shi, Tokyo 190 (JP)

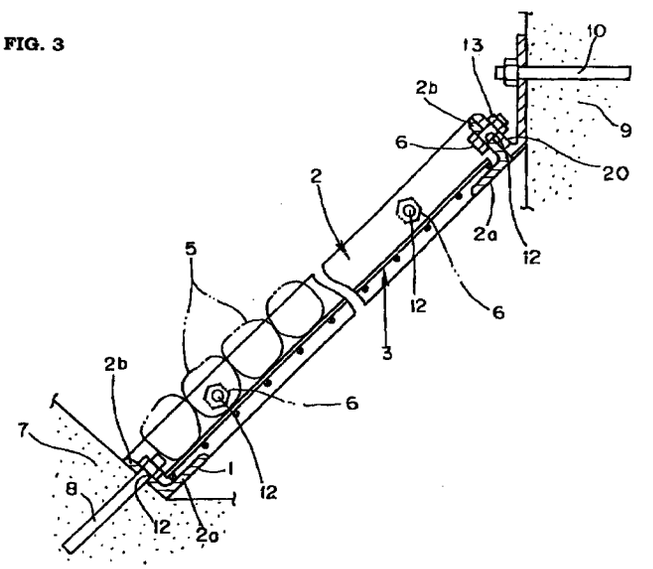
(72) Inventors:
- **YUKIMOTO, Isao**
  Tokyo 190 (JP)
- **HASEGAWA, Kiyonori**
  Tokyo 190 (JP)

(74) Representative:
Zinnecker, Armin, Dipl.-Ing. et al
Lorenz-Seidler-Gossel,
Widenmayerstrasse 23
80538 München (DE)

(54) REVETMENT, NATURAL STONE HOLDING UNIT ASSEMBLY AND NATURAL STONE HOLDING UNIT

(57) A revetment which is improved in workability while natural stones are used. A plurality of natural stone holding units (a) are laid on a slope (14a) to be reveted, leaving no space between them. In each natural stone holding unit (a), a plurality of natural stones (5) are bonded to a wire net (3) with adhesive, and a frame body (2) is provided on the entire peripheral portion of the wire net (3). The natural stone holding units (a) are connected to one another through the frame bodies (2) of adjacent natural stone holding units (a) to reinforcing the fixing of the plurality of natural stone holding units (a) to the slope (14a).

FIG. 3



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Description

TECHNICAL FIELD

The present invention relates to a revetment built of natural stones, as well as a natural stone holding unit assembly and a natural stone holding unit for building the revetment.

BACKGROUND TECHNOLOGY

As a method for building revetments, it is known a method for laying stones on a steep slope of an embankment or the like. This method involves stonemasons laying natural stones one by one by manual work and stuffing up spaces among the natural stones laid thereon with stones, thereby building a revetment with natural stones.

This method, however, suffers from the disadvantages that it becomes very difficult in itself to build a revetment on a place, for example, where water is flowing at a high speed or where the revetment is high (for example, as high as 2 meters or higher) due to instability of the laid natural stones as well as it takes a very long time for building the revetment.

Given the foregoing situation involved in building revetments, the present invention has been accomplished and it has the first object to provide a revetment having improved workability while natural stones are used.

The present invention has a second object to provide a natural stone holding unit assembly for building the revetment.

The present invention has a third object to provide a natural stone holding unit for building the revetment.

DISCLOSURE OF THE INVENTION

In order to achieve the first object of the present invention, the invention as described in claim 1 provides the construction of a revetment comprising a plurality of natural stones holding units laid in an adjacent state on a slope of an embankment etc. to be fortified, the natural stones holding unit being each formed with a plurality of natural stones bonded with adhesive to a plate-shaped holding member with a plurality of spaces and with a frame body disposed on the entire peripheral edge portion of the holding member; in which the plurality of natural stones holding units are connected to one another through the frame bodies of the adjacent natural stones holding units. Preferred features of this embodiment of the present invention as described in claim 1 are embodies in claims 2 and 3.

In order to achieve the second object of the present invention, the invention as described in claim 4 provides the construction of a natural stones holding unit assembly comprising a plurality of the natural stones holding units formed with the plurality of natural stones bonded with adhesive to the plate-shaped holding member with the plurality of spaces and with the frame body disposed on the entire peripheral edge portion of the plate-shaped natural stones holding member; in which the plurality of the natural stones holding units are connected to one another through the frame bodies of the natural stones holding units.

In order to achieve the third object of the present invention, the invention as described in claim 5 provides the construction of a natural stones holding unit comprising a plurality of the plate-shaped natural stones holding members each having natural stones bonded with adhesive and leaving the plurality of spaces; and the frame body provided on the entire peripheral edge portion of the plate-shaped natural stones holding member. Preferred features of this embodiment of the present invention as described in claim 5 are embodies each in claims 6 and 16.

The invention as described in claim 1 can lay a plurality of natural stones on a slope of an embankment or the like to be fortified simply by laying natural stones holding units on the slope thereof and carry the plurality of the natural stones to the slope thereof with promptness and with ease.

Further, this aspect of this invention can ensure a prevention of problems with certainty which may be caused, for instance, by natural stones discharging or coming off from the slope of the embankment to be fortified, falling down from the slope thereof and so on, because the discharging or coming off and the falling down of the natural stones from the slope thereof, etc. can be prevented due to the facts that the natural stones laid on the slope thereof are bonded to the plate-shaped natural stones holding member with adhesive and the plate-shaped natural stones holding members are held on the slope thereof on the basis of the weight of the natural stones holding units. Moreover, the invention can prevent the natural stones from being discharged or coming off or falling down from the slope of the revetment, etc. to a more certain extent, on the basis of the fact that the plurality of the natural stones holding units are connected to one another in addition to the above facts. Therefore, the present invention can improve workability in building the revetment with natural stones.

The frame body of the natural stones holding unit can readily connect adjacent natural stones holding units to each other and facilitate the work of connecting the natural stones holding units to one another. Further, it can reinforce the plate-shaped natural stones holding member leading to enhancing the strength of the natural stones holding unit.

The invention as described in claim 2 can further improve workability in building the revetment of the embankment or the like due to the fact that the plurality of the natural stones holding units are held more tightly to the slope of the embankment, etc. because among the plurality of the natural stones holding units, at least one of the plurality of the natural stones holding unit laid

in a lower position or laid in an upper position is connected through the frame body to the slope of the embankment to be fortified.

Further, the revetment of the embankment etc. can be maintained for a long period of time with certainty due to the more secure connection of the plurality of the natural stones holding units to the slope of the embankment or the like.

The invention as described in claim 3 can specifically achieve the actions and effects as achieved by the invention as described in claim 2 due to the fact that the frame body and the slope of the embankment etc. are connected to each other through edge concrete covering the slope thereof and an anchor disposed astride the edge concrete and the frame body.

In accordance with the invention as described in claim 4, a natural stones holding unit can be formed in an optional see by connecting a plurality of natural stones holding units to one another upon work for laying natural stones, whereby the invention can enhance the freedom and workability of laying natural stones when used for the revetment as described in claim 1.

As a matter of course, a combination of the natural stones holding units can ensure strength as an assembly because the natural stones holding units are provided each with a frame body.

The invention as described in claim 5 can achieve substantially the same actions and effects as described in claim 1 when used for the revetment as described in claim 1 as a natural stones holding unit due to the fact that a plurality of natural stones are bonded with adhesive to the plate-shaped holding member with a plurality of spaces and the frame body is provided on the entire peripheral edge portion of the plate-shaped natural stones holding member.

As the frame body is provided on the entire peripheral edge portion of the plate-shaped natural stones holding member in accordance with the invention as described in claim 6, the adjacent natural stones holding units can be connected to one another with ease and a sufficient strength of each of the natural stones holding units can be ensured because the frame body is provided on the entire peripheral edge portion of the plate-shaped natural stones holding member.

The invention as described in claim 7 can enhance workability in the work for laying the natural stones holding units on the basis of the fact that the frame body and the plate-shaped natural stones holding member are each of a rectangular shape and the natural stones holding unit is of a rectangular shape, thereby enabling the natural stones holding units to be laid on the slope of the embankment etc with accuracy, leaving no spaces between the natural stones holding units laid thereon.

In accordance with the invention as described in claim 8, the frame body is provided with a connecting element so that this connecting element can be utilized for connecting the natural stones holding units to one another or connecting the natural stones holding units to the slope of the embankment etc. Therefore, the invention as described in claim 8 can perform the work of connection with promptness and with readiness.

The invention as described in claim 9 can specifically achieve substantially the same actions and effects as achieved by the invention as described in claim 8 because the natural stones holding units can be connected to one another through a mounting hole formed in the connecting element or the natural stones holding units can be connected to the slope of the embankment etc therethrough by inserting a bolt or the like through the mounting hole.

The invention as described in claim 10 also can specifically achieve substantially the same actions and effects as achieved by the invention as described in claim 8 because the connecting element is disposed so as to work as a fixing anchor for fixing to the slope of the embankment etc and the natural stones holding units can be connected to one another or the natural stones holding units can be connected to the slope of the embankment etc through the fixing anchor.

In accordance with the invention as described in claim 11, the frame body can work effectively for connection of the natural stones holding units to one another and enhancement of each of the natural stones holding units due to the fact that the frame body is made of a ferrous metal such as an iron and the strength of the frame body is high enough.

Further, in accordance with the invention as described in claim 12, the frame body is made from a generally sectionally L-shaped angle bar and the angle bar is such that a curved portion on a one side thereof supports the peripheral edge portion of the holding member thereon and a curved portion on the other side thereof projects upwardly, so that the holding member can be accurately held with the angle bar and at the same time the natural stones holding units can be connected to one another with the aid of the curved portion on the other side of the angle bar directed projecting upwardly without undergoing interference.

The invention as described in claim 13 can enhance the strength of the holding member with certainty and achieve higher performance of building the revetment and the like with improved workability due to the fact that the peripheral edge portion of the holding member is welded to the frame body because the holding member is made of a metal and the frame body is made of a ferrous metal.

In accordance with the invention as described in claim 14, the frame body is made from a sectionally L-shaped angle bar and the curved portion on the one side of the angle bar is welded to the peripheral edge portion of the holding member, so that the holding member and the frame body are formed integrally with each other and the curved portion on the other side of the angle bar is disposed so as to enclose the periphery of the holding member, thereby preventing the peripheral

edge portion, such as an edge portion, a tip portion, etc. of the plate-shaped natural stones holding member from being exposed to the outside. This construction makes it easy to handle the holding member and so on upon the work of carrying or laying them and can improve workability.

The invention as described in claim 15 can specifically achieve substantially the same actions and effects as achieved by the invention as described in claim 13 or 14 because the holding member is made from a wire net and the wire net is made of a ferrous metal material.

Moreover, the invention as described in claim 16 can prevent the natural stones from coming off from the holding member due to the fact that the holding member can be readily adapted to the slope of the embankment etc because the plurality of the spaces formed in the holding member are in the form of a network or a meshwork and an external force or an impact force acting upon the natural stones can be absorbed effectively by the holding member with such a network or a meshwork.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

Fig. 1 is a longitudinal view in section showing a steep slope of an embankment of a river according to an embodiment of the present invention.

Fig. 2 is a plan view showing a portion of the revetment of the embankment in accordance with a working mode of the embodiment of the present invention.

Fig. 3 is a side view showing a portion of the revetment of the embankment as shown in Fig. 1.

Fig. 4 is an enlarged sectional view as taken along line A-A of Fig. 2.

Fig. 5 is a plan view showing a natural stones holding unit for use with the revetment of the embankment in accordance with a working mode of the embodiment of the present invention.

Fig. 6 is a side view of Fig. 5.

BEST MODES OF CARRYING OUT THE INVENTION

The present invention will be described in more detail by way of examples with reference to the accompanying drawings.

As shown in Figs. 1 to 3, a revetment 14 formed for fortification of an embankment of a river etc. in accordance with an embodiment of the present invention is provided with a plurality of natural stones holding units a. As shown in Figs. 5 and 6, each of the natural stones holding units a holds a wire net 3 as a holding member horizontally within a frame body 2 and natural stones 5 are bonded to the surface of the wire net 3 with adhesive such as epoxy resin or the like.

In this embodiment, the frame body 2 is formed in a rectangular shape, for example, specifically in a square shape in this embodiment. The frame body 2 may be made from a steel angle bar of a ferrous metal material and it may be in a generally L-shaped form in section as shown in Figs. 3 and 4. The frame body 2 has a curved portion 2a on a one side thereof, on the one hand, formed so as to comprise a surface to receive a peripheral edge portion of the wire net 3 and a curved portion 2b on the other side thereof, on the other, formed projecting upwardly and provided with an aperture 12 as a mounting hole in an appropriate position on each of the side portions.

It is to be noted herein as a matter of course that a highly rigid plastic concrete may also be used as the frame body 2 in place of the steel angle bar.

The wire net 3 may be formed in a rectangular shape so as to be adapted to the frame body 2. The wire net 3 has a network formed as a plurality of spaces and a peripheral edge portion thereof supported on the curved portion 2a on the one side of the frame body 2 as shown in Figs. 3 to 5. In this case, the peripheral edge portion of the frame body 2 is fixed to the curved portion 2a on the one side thereof by means of placement, welding or bonding with adhesive or the like.

It is to be noted herein as a matter of course that in place of the wire net 3, there may be used a synthetic resin net or a wire fixed horizontally so as to cover the frame body 2, the synthetic resin net or a wire being provided with a network or a meshwork as a plurality of spaces.

As natural stones 5, there may be employed, for example, round stones and crushed stones as they are without shaping. The size of the natural stones may range from 100 mm to 500 mm in diameter. A plural number of such natural stones 5 are prepared and a plurality of natural stones 5 are bonded with adhesive to the wire net 3 so as to fail to protrude from each side of the peripheral edge portion of the frame body 2 in this embodiment.

As shown in Figs. 1 to 3, the plurality of the natural stones holding units a are laid one over another from the lower row toward the upper row along a slope 14a of the revetment 14 of a river etc. (although the slope 14a thereof etc are not shown in Fig. 3) and laid in plural numbers and rows in an adjacent state in which the natural stones holding unit on the left-hand side is disposed adjacent the natural stones holding unit on the right-hand side and the lower row of the natural stones holding units is disposed adjacent the upper row of the natural stones holding units. The plurality of the natural stones holding units a are connected to one another and arranged integrally with one another by aligning the apertures 12 of the adjacent frame bodies 2, that is, the natural stones holding unit on the left-hand adjacent the natural stones holding unit on the right-hand side and the natural stones holding unit in the lower row adjacent the natural stones holding unit in the upper row, inserting a bolt 6 through the aligned apertures 12 and engaging the bolt 6 with a nut 13.

In the case as described above, as shown in Fig. 1,

a concrete foundation 7 is deposited on the bottom portion of the revetment 14, when the frame bodies 2 are laid in a height exceeding 2 meters. The concrete foundation 7 is embedded at its bottom portion with an anchor 8 which extends downwardly from the frame body 2 laid in the lower position through the aperture 12, as shown in Fig. 3. The anchor 8 can fix the frame body 2 of the natural stones holding unit a through the concrete foundation 7 to the bottom portion of the revetment 14.

Further, in this case, as shown in Fig. 1, the revetment 14 is deposited at its top portion with a levee crown concrete 9. The levee crown concrete 9 is also embedded with an anchor 10 which extends from the frame body 3 laid in the upper position, as shown in Fig. 3. The anchor 10 can fix the frame body 2 of the natural stones holding unit a through the levee crown concrete 9 to the upper portion of the revetment 14.

In this case, the anchor 10 is mounted each on a plurality of mounting brackets 20, in this embodiment, and the plurality of the mounting brackets 20 are mounted on the frame body 2 with bolts 6 and nuts 13 at given intervals in the breadthwise direction of the frame body 2 (in the perpendicular direction with respect to the paper surface as shown in Fig. 3).

As shown in Fig. 1, there is interposed a suction preventive material 11 between the plurality of the natural stones holding units a and the slope 14a of the embankment etc. The suction preventive material 11 is laid on the slope 14a thereof and can prevent earth and rocks from falling down from gaps between the natural stones 5.

For the wire net 3 and the frame body (steel angle bar) 2, it is preferred to use a highly durable material plated with zinc, zinc-aluminum or the like.

With the arrangement of the construction in the manner as described hereinabove, the revetment 14 can be built in such a construction as natural stones are laid so that it can provide a place, for instance, where plants can grow naturally and birds can build their nests. Further, for the revetment 14 according to the present invention, a plurality of natural stones 5 can be laid on the slope 14a of the embankment etc. for forming the revetment 14 simply by locating a plurality of the natural stones holding units a on the slope 14a of the embankment for formation of the revetment 14. Moreover, the present invention can also be used as a means for carrying the natural stones 5 to the slope 14a thereof upon formation of the revetment 14, which allows the plurality of the natural stones 5 to be promptly and readily carried to the slope 14a of the revetment 14.

In this case, a plurality of the natural stones holding units a can be connected together to form an assembly of the natural stones holding units a in an optional size. This can offer high freedom and improve workability of the work for laying the natural stones.

In this construction, it can be noted herein as a matter of course that the assembly can sustain its strength because each of the natural stones holding units a is provided with the frame body 2 over the entire length of the peripheral edge portion thereof.

Upon formation of the revetment, the present invention can prevent the natural stones 5 from flowing out or failing down etc from the slope 14a of the revetment 14 because each of the natural stones 5 is bonded to the wire net 3 on the slope 14a of the embankment and the wire net 3 is held on the slope 14a thereof on the basis of the own weight of the natural stones holding units a. Further, the present invention can prevent the natural stones 5 from flowing out and falling down from the slope 14a of the revetment 14 because the plurality of the natural stones holding units a are connected to one another and each of the natural stones holding units a is held firmly on the slope 14a of the embankment. Therefore, the present invention can improve workability of forming the revetment 14 while using natural stones 5.

Moreover, in this embodiment of the present invention, in addition to the connection among the frame bodies 2 of the natural stones holding units a, the natural stones holding unit a located in the lower position and the natural stones holding unit a located in the upper position are connected to the slope 14a of the embankment through the frame bodies 2 and the anchor 10 so that the plurality of the natural stones holding unit a can be held on the slope 14a thereof to a firmer extent.

In this construction, upon forming the revetment 14, the frame body 2 of each of the natural stones holding unit a can assist in facilitating the work of connecting the natural stones holding units a to one another because it can perform a ready connection of the adjacent natural stones holding units a to each other as well as in enhancing the strength of the natural stones holding unit a in association with enforcement by means of the wire net 3.

Particularly, in the embodiment where there is used the frame body 2 made from a steel angle bar of a generally sectionally L-shaped form, the present invention can offer the advantages that the work of connecting the natural stones holding units a can be carried out with certainty and without interference with each other because the frame body 2 is held at the curved portion 2a on the one side thereof firmly on the peripheral edge portion of the wire net 3 and the natural stones holding units a can be connected to one another through the curved portion 2b on the other side thereof projecting upwardly.

Further, in this embodiment, the present invention can present the advantages that the work of connecting the natural stones holding units a to one another and connecting natural stones holding units a to the slope 14a of an embankment of a river etc can be conducted with promptness and with ease because they can be connected effectively by means of the connecting elements such as the apertures 12, bolts 6, and anchors 8 and 10.

Moreover, it is noted herein that although the above

embodiments of the present invention can be effectively applied to an embankment having a steep slope (for example, at 45 degree or greater), the present invention can also be applied as a matter of course to an embankment having a lesser steep slope.

Claims

1. A revetment comprising:

   a plurality of natural stones holding units each having a plurality of natural stones bonded with adhesive to a plate-shaped holding member with a plurality of spaces and having a frame body provided on a peripheral edge portion of the holding member;

   wherein the plurality of the natural stones holding units are laid on a slope of an embankment in a state in which the plurality of the natural stones holding units are disposed adjacent one another; and

   wherein the plurality of the natural stones holding units are connected to adjacent natural stones holding units through the frame bodies thereof.

2. The revetment as claimed in claim 1, wherein among the plurality of the natural stones holding units at least one of the natural stones holding unit located in an upper position and the natural stones holding unit located in a lower position is connected to the slope of the embankment through the frame body thereof.

3. The revetment as claimed in claim 2, wherein the frame body of the natural stones holding unit is connected to the slope of the embankment through an edge concrete formed on the slope thereof and through an anchor disposed astride the edge concrete and the frame body.

4. A natural stones holding unit assembly comprising:

   a plurality of natural stones holding units each having a plurality of natural stones bonded with adhesive to a plate-shaped holding member with a plurality of spaces and having a frame body provided on a peripheral edge portion of the holding member;

   wherein the plurality of the natural stones holding units are connected to one another through each of the frame bodies thereof.

5. A natural stones holding unit comprising:

   a plate-shaped holding member having a plurality of natural stones bonded with adhesive thereto, the plate-shaped natural stones holding member having a plurality of spaces; and

   a frame body provided on a peripheral edge portion of the plate-shaped natural stones holding member.

6. The natural stones holding unit as claimed in claim 5, wherein the frame body is provided on the entire length of the peripheral edge portion of the plate-shaped natural stones holding member.

7. The natural stones holding unit as claimed in claim 6, wherein each of the frame body and the plate-shaped natural stones holding member is in a rectangular form.

8. The natural stones holding unit as claimed in any one of claims 5 to 7, wherein the frame body is provided with a connecting element.

9. The natural stones holding unit as claimed in claim 8, wherein the connecting element is a mounting hole.

10. The natural stones holding unit as claimed in claim 8, wherein the connecting element is an anchor for fixing to a revetment of an embankment.

11. The natural stones holding unit as claimed in any one of claims 5 to 10, wherein the frame body is made of a ferrous metal.

12. The natural stones holding unit as claimed in claim 11, wherein:

    the frame body is an angle member in a generally L-shaped form in section; and

    a curved portion on a one side of the angle member is disposed to support a peripheral edge portion of the plate-shaped natural stones holding member; and

    a curved portion on another side of the angle member is disposed projecting upwardly.

13. The natural stones holding unit as claimed in any one of claims 5 to 10, wherein:

    the plate-shaped natural stones holding member is made of a metal;

    the frame body is made of a ferrous metal; and

    a peripheral edge portion of the plate-shaped natural stones holding member is welded to the frame body.

14. The natural stones holding unit as claimed in claim 13, wherein:

    the frame body is an angle member of a gener-

ally L-shaped form in section; and

a peripheral edge portion of the plate-shaped natural stones holding member is welded to a curved portion on a one side of the angle member.

15. The natural stones holding unit as claimed in claim 13 or 14, wherein the plate-shaped natural stones holding member is made from a wire net.

16. The natural stones holding unit claimed in any one of claims 5 to 15, wherein a plurality of spaces of the plate-shaped natural stones holding member are formed in a network structure or a meshwork structure.

FIG. 1

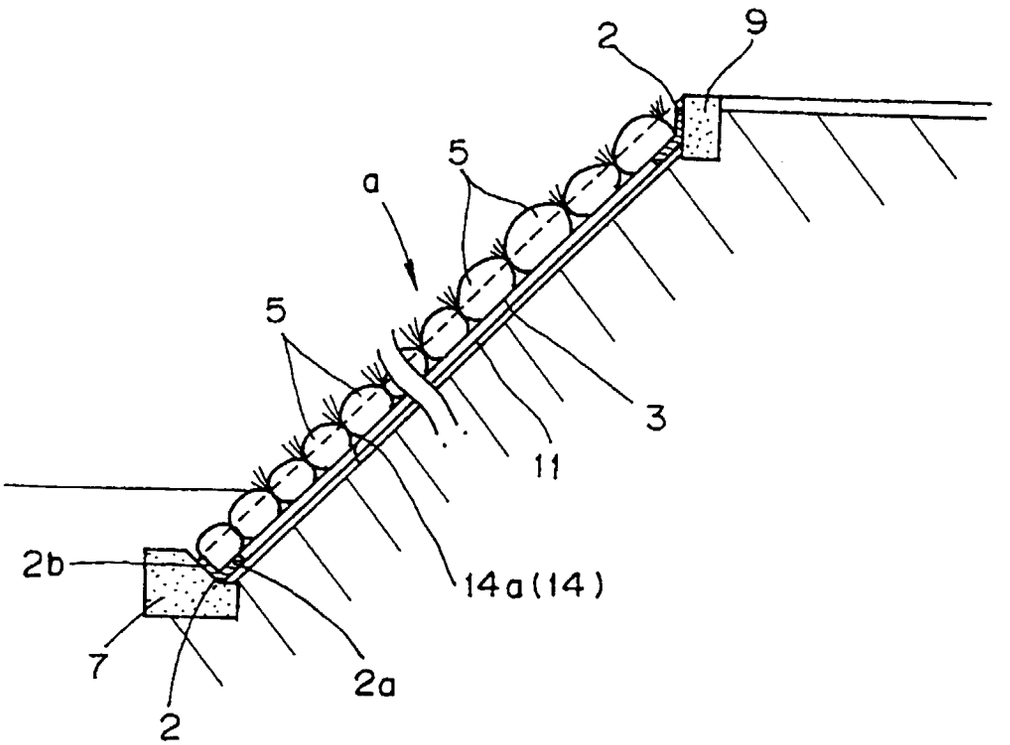
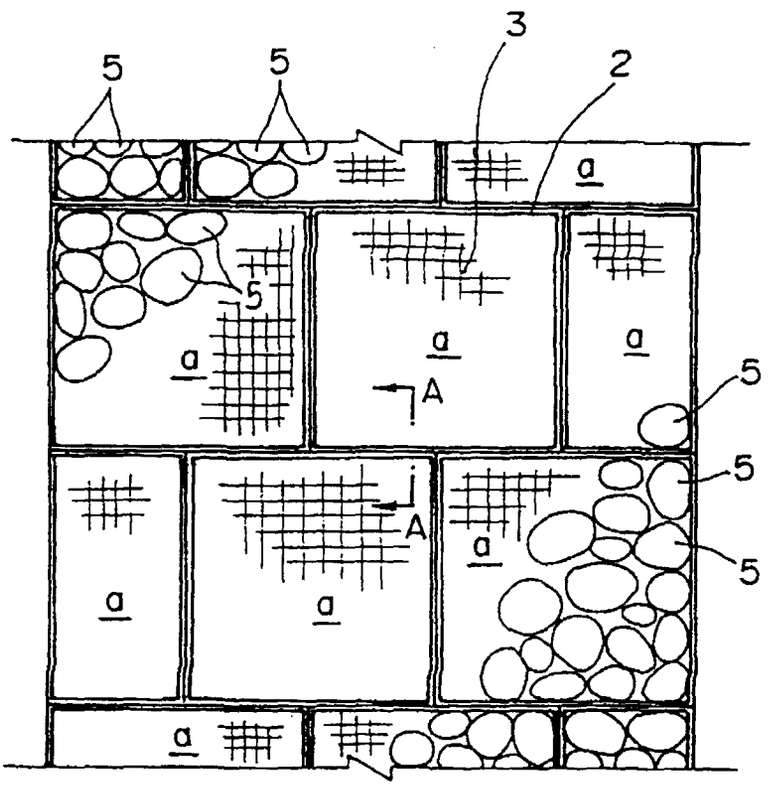


FIG. 2



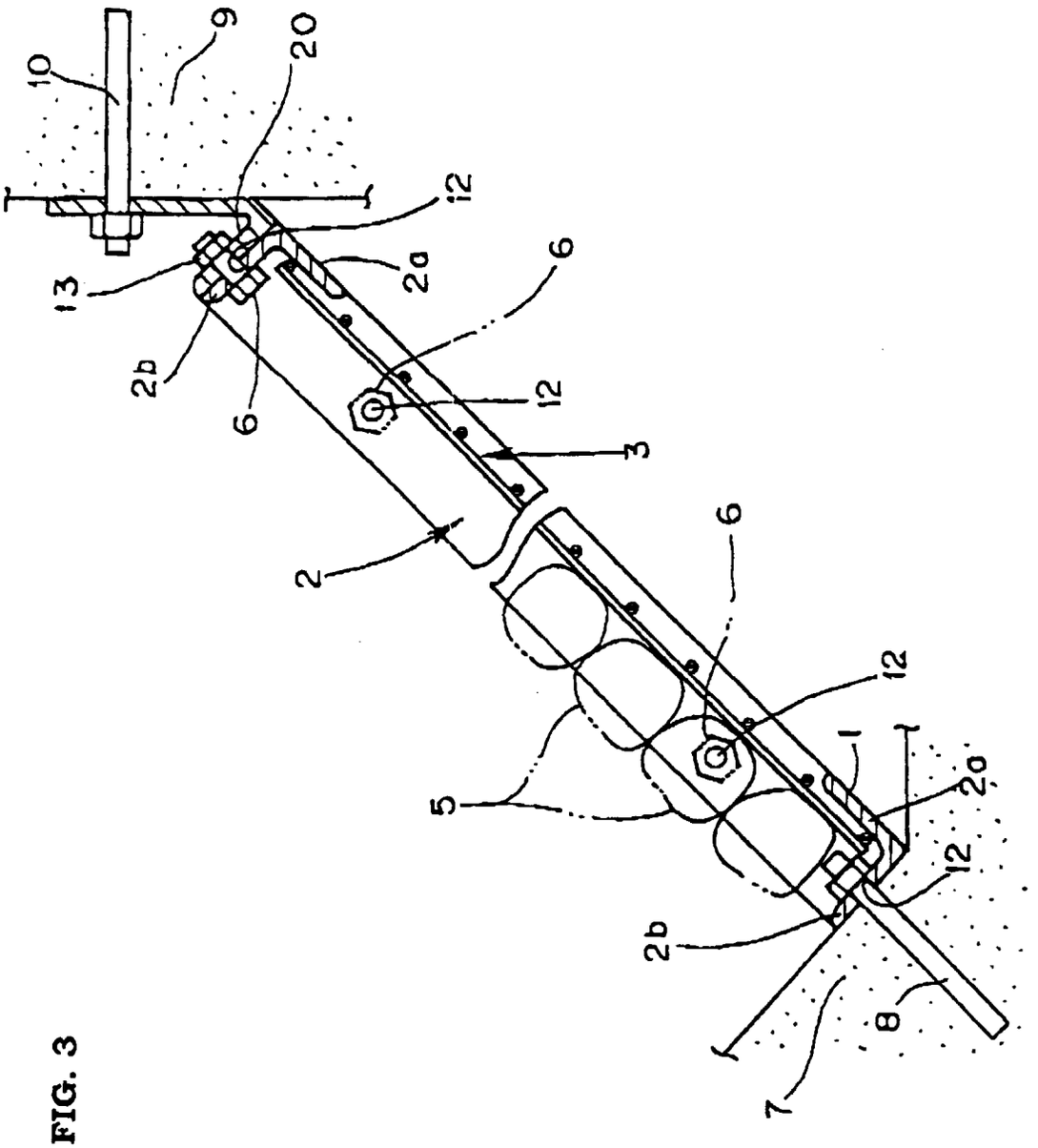


FIG. 3

FIG. 4

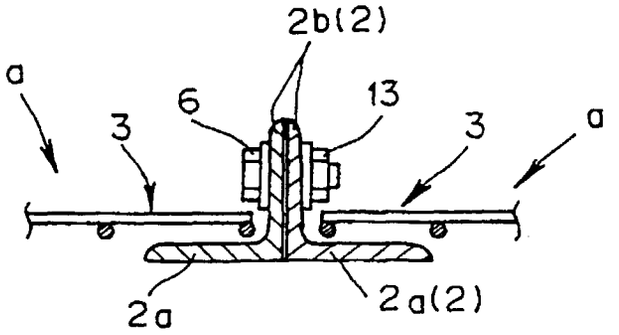


FIG. 5

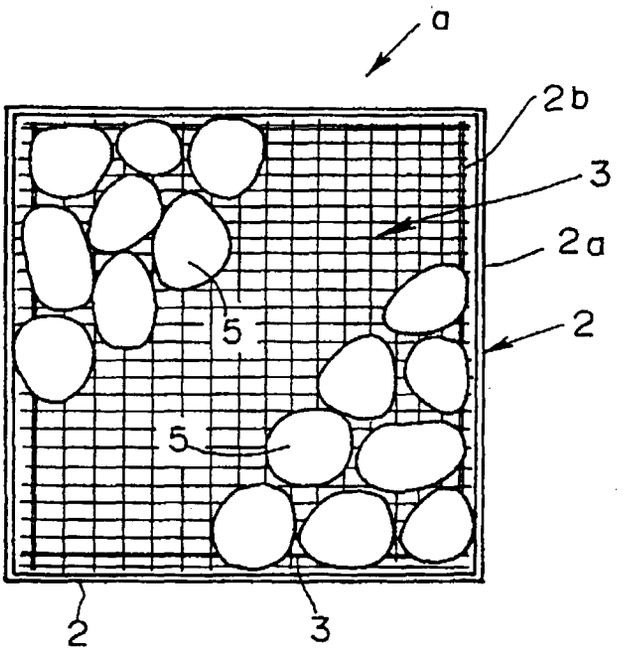
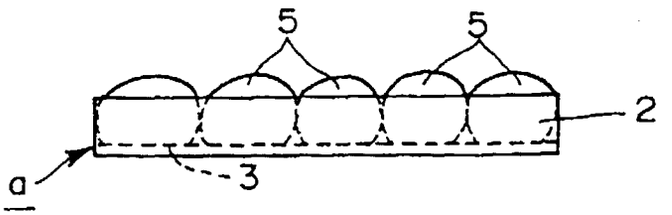


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP96/03546

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 E02B3/12

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)

Int. Cl^6 E02B3/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922 - 1997
Kokai Jitsuyo Shinan Koho	1972 - 1997
Toroku Jitsuyo Shinan Koho	1994 - 1997

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PATOLIS, Inventor "Isao Yukimoto"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 7-82720, A (Kankyo Kogaku K.K.), March 28, 1995 (28. 03. 95)(Family: none)	1 - 16
A	JP, 7-31944, U (Masashi Yukimoto), June 16, 1995 (16. 06. 95)(Family: none)	1 - 16
A	JP, 7-35521, U (Kankyo Kogaku K.K.), July 4, 1995 (04. 07. 95)(Family: none)	1 - 16
A	JP, 7-35522, U (Kankyo Kogaku K.K.), July 4, 1995 (04. 07. 95)(Family: none)	1 - 16
A	JP, 3011659, U (Kankyo Kogaku K.K.), May 30, 1995 (30. 05. 95)(Family: none)	1 - 16

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search	Date of mailing of the international search report
March 4, 1997 (04. 03. 97)	March 11, 1997 (11. 03. 97)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)