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**US-A1- 2014 010 601**



# DESCRIPTION

## Technical Field

**[0001]** The present invention relates to a scour prevention unit, and in particular, relates to a scour prevention unit used for scour prevention at the foundation of a windmill for offshore wind power generation.

## Background Art

**[0002]** There conventionally have been methods for configuring a structural body using a suction prevention sheet to prevent scouring at rivers and levees. Such examples are disclosed in Japanese Unexamined Patent Publications No. 2001-262577 (Patent Document 1), No. 2002-121720 (Patent Document 2), and No. 2015-31148 (Patent Document 3).

**[0003]** Patent Document 1 discloses a configuration installing a suction prevention sheet accurately and firmly to a support frame, and on a suction prevention sheet laid on the foundation ground, disposing a huge stacking work (indicative of sandbag stacking work, basket stacking work and the like that is shaped rectangular or elliptic having a volume of at least about two cubic meters) to establish mechanized construction, and further simultaneously constructing a stacking work portion and a banking portion completely separated by the support frame and the suction prevention sheet to strive for shortening the working period.

**[0004]** Patent Document 2 discloses a configuration in which a basket drain section is formed on a land side of a levee body, which basket drain section causes infiltration water of the levee body to flow therein by a filling basket filled with rough grain filter material in a steel assembly net, to form a drain layer by covering rough grain filter material on a foundation ground between this basket drain section and a levee foot waterway at the foot of a slope, and this basket drain section and drain layer is covered with levee soil, and the infiltration water flown into the basket drain section is guided to the levee foot waterway through the drain layer.

**[0005]** Patent Document 3 discloses a configuration including an outer cylindrical body disposed within a top-covered coating concrete of a levee body, a lid body that usually tightly closes an upper opening of the outer cylindrical body, a settlement plate that settles in the outer cylindrical body along with the settlement of levee soil, and a check valve, wherein the lid body is detachable by being blown away by compressed air generated within the outer cylindrical body by lifting pressure received by the levee due to an increase in water level.

**[0006]** On the other hand, there are cases using only a conventional bag body containing crushed stone without using a suction prevention sheet. This case is described in detail. Fig. 7 shows a cross-sectional view of a case in which a bag body 101 containing only crushed stone

is disposed at the root of a pier in a river 110, without using a suction prevention sheet. Moreover, Fig. 8 shows a cross-sectional view of a case in which bag bodies 102 containing only crushed stone are disposed at the bottom of the river, for bank protection of the river 110.

**[0007]** KR 2013 0051565 A describes a gabion comprising a mesh, a band, and a ground protective cloth. The band is connected to the mesh by crossing the outer surface. The ground protective cloth is connected to the inside of the mesh through a connecting rope.

**[0008]** KR 10 1 320 455 B1 describes a gabion with multi-packed meshes that is packed with at least two packing units by putting a small stone mesh into a large packing unit. A reinforcing unit is installed at a cross section of fibers. The reinforcing unit comprises an U-bolt, a fixing plate, and a nut.

**[0009]** US 5 951 202 A describes an instant shoreline erosion-preventing bank installation comprising a vegetation supporting strengthened skin having negatively-buoyant bottom and side drop-skirts, which skirts each include an extendable reservoir of skin folded on itself accordion-like, and which skirts each include at least one weight. The side and bottom negatively-buoyant drop-skirts of the vegetation supporting strengthened skin fall as the bank is eroded by wave action, conforming the skin to the bank as it erodes in a storm, thereby preventing wash-away of the installation.

## **Citation List**

## **Patent Literatures**

### **[0010]**

[Patent Document 1] Japanese Unexamined Patent Publication No. 2001-262577 (Abstract etc.)

[Patent Document 2] Japanese Unexamined Patent Publication No. 2002-121720 (Abstract etc.)

[Patent Document 3] Japanese Unexamined Patent Publication No. 2015-031148 (Abstract etc.)

## **Summary of Invention**

## **Technical Problem**

**[0011]** A conventional bag body for scour prevention containing only crushed stone was configured as described above, and was placed at the bottom of the river 112. In the case of the bottom of the river 112, sediments of minute particles are usually carried by the waterflow of the river and only sediments of particles greater than a certain size remain. Therefore, just disposing the conventional bag body containing only crushed stone achieves the scour protecting function.

**[0012]** Figs. 9(A) to 9(C) are views for describing the problems in a case of using the conventional bag body 101 containing only crushed stone at the seabed. Fig. 9(A) shows an initial state of the bag body 101 containing only crushed stone being placed on a surface 122a of a sand layer 122, in a case in which the sand layer 122 exists on a surface 121a of a clay layer 121 of the seabed 120, Fig. 9(B) shows a state after elapse of a predetermined period, and Fig. 9(C) is a view showing a final placed state. In a case of disposing the conventional bag body 101 containing only crushed stone for the purpose of scour protection around a structure disposed on the seabed as like in Fig. 9(A), since sand of minute particles accumulate on the seabed to form the sand layer 122, as time elapses, the sand in the sand layer 122 is suctioned above (shown by curved line in the arrows in the drawing) from below the bag body 101 by a tide 124 flowing above the bag body 101 as in Fig. 9(B), and as time elapses further, the bag body 101 containing only crushed stones sinks to the clay layer 121 as a result of having no sand left as in Fig. 9(C). As a result, there was the problem that a seabed structure 123 cannot be supported vertically, and thus the seabed structure 123 inclines (in Fig. 9(C), the surface 122a of the original sand layer is shown in dotted lines, and the sea surface is shown as 125).

**[0013]** [0007] Moreover, if this is simply a method of scattering crushed stone separately, there was the problem that it would take extra time and cost in the case of a small-scale construction, and that under an environment with fast tide and high waves, the crushed stone will become carried away, thus being unable to prevent scouring.

**[0014]** This invention is accomplished in view of the above problems, and an object thereof is to provide a scour prevention unit that causes no infiltration of sand from below a placement surface of a scour prevention unit as like a bag body housing block objects such as crushed stone.

### **Solution to Problem**

**[0015]** The object is attained by a scour prevention unit according to claim 1 or by a scour prevention method according to claim 5. Further developments of the invention are indicated in the dependent claims, respectively.

### **Advantageous Effects of Invention**

**[0016]** In this invention, since the cloth is fixed below the bag body outside the bag body by fixing means, even if the bag body is placed on a sandy place, sand will not infiltrate upwards through the bag body.

**[0017]** As a result, it is possible to provide a scour prevention unit in which no suction of sand occurs from the bottom of a placement surface of the bag body including block objects such as crushed stone.

### **Brief Description of Drawings**

#### **[0018]**

[Fig. 1] Fig. 1 is a schematic view showing a first embodiment of a scour prevention unit which does not form part of this invention.

[Fig. 2] Fig. 2 is a plan view showing a set state of the scour prevention unit of the first embodiment.

[Fig. 3] Fig. 3 is a schematic view showing a second embodiment of the scour prevention unit which is a part of this invention.

[Fig. 4] Fig. 4 is a plan view showing a set state of the scour prevention unit of the second embodiment.

[Fig. 5] Fig. 5 is a side view showing a set state of the scour prevention unit of the second embodiment.

[Fig. 6] Fig. 6 is a view showing a specific set state of the scour prevention unit of the second embodiment.

[Fig. 7] Fig. 7 is a view showing a setting example of a conventional bag body containing crushed stone only.

[Fig. 8] Fig. 8 is a view showing a setting example of a conventional bag body containing crushed stone only.

[Fig. 9] Fig. 9 is a view showing a setting example of a conventional bag body containing crushed stone only.

### **Description of Embodiments**

**[0019]** A scour prevention unit 10 includes a bag body 11 housing block objects 12 such as a plurality of crushed stone in a bag material 13, and a cloth 16 integrated with the bag body 11. Here, the cloth is indicative of one in which a plurality of fibers is processed into a thin and broad sheet. Depending on the manufactured method, the cloth is classified into woven fabric, knitted fabric (knit fabric), lace, felt, and nonwoven fabric.

**[0020]** The block objects are crushed stone, concrete blocks, cobblestones, broken stones, ironstone, rubber tire and the like having a specific gravity exceeding 1, preferably not less than 1.5, more preferably not less than 2.0. Moreover, the bag material is one configured by a net.

**[0021]** Fig. 1 is a schematic view of a scour prevention unit 10a according to a first embodiment. Fig. 1(A) is a cross-sectional view, and Fig. 1(B) is a perspective view. With reference to Figs. 1(A) and 1(B), the scour prevention unit 10a includes a bag body 11 which houses block objects 11 in a bag material 13 with block objects 11 placed on a cloth 16 and is placed on the seabed. In Fig. 1(B), the cloth 16 is made larger than a placement surface of the bag body 11, and displays a state in which one part is viewable from top view. Fig. 1(B) shows in white a part in which one portion 16a of the cloth 16 is covering the block objects inside, shows the block objects 12 at center parts, and shows a state in which the mesh-form bag material 13 covers by the whole.

**[0022]** This is preferable for fixing the cloth 16 to the bag body 11, to securely house the cloth 16 below the block objects 12 and also to prevent the cloth 16 from moving inside the bag body 11. To fix the cloth to the bag body 11, a string with a hook may be provided for example at edges of four corners or in its vicinity of the cloth 16, to use this hook to fix the bag body 11 at predetermined locations. Moreover, the cloth 16 is preferably larger than the placement surface of the bag body 11 (circular projected plane of the scour prevention unit 10a in Fig. 2(B), described later).

**[0023]** By configuring as such, the block objects 12 will be placed and maintained on the cloth 16 within the bag body 11; hence, even if the bag body is placed on a sandy place, sand will not infiltrate upward through the bag body 11.

**[0024]** As a result, it is possible to provide a scour prevention unit in which no suction of sand occurs from below the placement surface of the bag body containing crushed stone.

**[0025]** Next describes a setting method in a case of setting a plurality of the scour prevention units 10a according to the first embodiment. Fig. 2(A) is a plan view showing a conventional method of setting the bag body 101, and Fig. 2(B) is a plan view showing a method according to this embodiment of setting the scour prevention unit 10a. In a case of setting a plurality of the conventional bag bodies 101, the bag bodies were arranged on the seabed with no parts overlapping and so that their peripheries touch each other. In comparison, in a case of setting a plurality of the scour prevention units 10a according to the first embodiment, the plurality of scour prevention units 10a are arranged on the seabed 120 so as to overlap each other, as

shown in Fig. 2(B). Fig. 2(C) is a cross-sectional view taken on IIC-IIC in Fig. 2(B).

**[0026]** By arranging as such, it is possible to prevent the suction of sand from the seabed more effectively.

**[0027]** Next describes a scour prevention unit 10b according to a second embodiment. Fig. 3 is a schematic view showing the scour prevention unit 10b according to the second embodiment. Fig. 3(A) is a cross-sectional view, and Fig. 3(B) is a view showing details of a fixing portion of the bag body 11 to the cloth 16, which bag body 11 contains the block objects 12.

**[0028]** With reference to Figs. 3(A) and 3(B), in this embodiment, the cloth 16 is integrated and fixed below the bag body 11 containing the block objects 12. The fixing means 18 includes an attachment string 20 having on its tip a hook 19 to attach on the periphery of the bag body 11, and has a fixing part 21 that fixes one part of the cloth 16b to an end of the attachment string 20 not having the hook 19 attached. In this embodiment, one fixing means 18 is provided for one bag body 11, however this number may be increased if necessary.

**[0029]** In this embodiment, since the scour prevention unit 10b has the cloth 16 provided integrally below the bag body 11 by the fixing means 18, the scour prevention unit 10b is placed on the seabed in a state in which the cloth 16 is laid below the block objects 12. Even if the bag body 11 is placed on a sandy place, the cloth 16 is below the bag body 11, so the sand will not infiltrate upwards through the bag body 11. As a result, it is possible to provide a scour prevention unit in which no suction of sand occurs from below the placement surface of the bag body 11 containing the block objects 12.

**[0030]** Since the cloth 16 is preferably water-permeable, a nonwoven fabric or mesh sheet is preferable. In the case of the mesh, the eye of the mesh is preferably sized as 5 mm, and more preferably is not more than 2 mm.

**[0031]** Next describes a setting method in the case of setting the scour prevention unit 10b according to the second embodiment. Fig. 4(A) is a plan view showing the cloth 16 of a rectangular shape arranged below the scour prevention unit 10, Fig. 4(B) is a plan view showing a state arranging the bag body 11 of a bun shape on the rectangular cloth 16 shown in Fig. 4(A), and Fig. 4(C) is a plan view of a case of arranging three bag bodies 11 adjacent to each other on the rectangular cloth 16. Moreover, a cross-sectional view of the arrangement of Fig. 4(C) is shown in Fig. 5.

**[0032]** With reference to Figs. 4 and 5, in this embodiment, since a plurality of bag bodies 11a is placed on one piece of cloth 16a, it is possible to place a plurality of bag bodies 11 at once. In this case, each of the plurality of bag bodies 11 is preferably fixed to the rectangular cloth 16 individually by using the fixing means as like those shown in Fig. 3(B). The three bag bodies may be connected in the lateral direction in advance and then be fixed to the cloth.



**[0033]** Moreover, this embodiment describes a case of arranging three bag bodies adjacent to each other on one rectangular cloth, however it is not limited to this; two, or four or more may be placed. Furthermore, a case of placing in a line in one direction is described, however it is not limited to this, and may be aligned in array form in vertical and horizontal directions.

**[0034]** Next describes a setting method in a case of setting the scour prevention unit 10b according to a third embodiment. Fig. 6(A) is a plan view showing a triangular cloth 16b arranged below the scour prevention unit 10, and Fig. 6(B) is a cross-sectional view showing a state arranging the bun-shaped bag body 11 on the triangular cloth 16b shown in Fig. 6(A). As shown in Figs. 6(A) and 6(B), three bag bodies 11b are arranged adjacent to each other on the triangular cloth 16b. In this embodiment also, since a plurality of the bag bodies 11b are placed on one piece of the cloth 16b, it is possible to place a plurality of the bag bodies 11b at once. In this case, each of the plurality of the bag bodies 11 is preferably fixed on the triangular cloth 16b individually, by using the fixing means as like those shown in Fig. 3(B). The three bag bodies may be connected at their adjacent sides in advance, and then fixed to the cloth 16b.

**[0035]** Moreover, this embodiment describes a case of arranging three bag bodies on the one triangular cloth, having one bag body positioned upper and two bag bodies positioned lower and adjacent to each other, however it is not limited to this; any polygonal shape may be used, or a circular cloth may be used and any number of bag bodies may be placed thereon.

**[0036]** By arranging the bag bodies 11 on the cloth 16 as such, it is possible to effectively prevent the suction of sand from the seabed, as with the previous embodiment.

**[0037]** Moreover, in this embodiment, a cloth of any desired shape may be prepared, and any number of bag bodies may be fixed thereon.

**[0038]** The embodiment described above describes a case in which, in the scour prevention unit, the cloth is either housed in the bag material and laid below the block objects or is fixed below the bag body outside the bag body by the fixing means, however it is not limited to this. The cloth may be housed in the bag material and laid below the block objects, while also having the cloth be fixed below the bag body outside the bag body by the fixing means. Having such configuration will further effectively prevent the suction of sand from the seabed.

**[0039]** The embodiments are described with reference to the drawings, however the present invention is not limited to the illustrated embodiments, but is defined by the appended claims. Various modifications may be made to the illustrated embodiments.

### **Industrial Applicability**

**[0040]** According to this invention, it is possible to provide a scour prevention unit in which no suction of sand occurs from below a placement surface. Hence, this invention can be used advantageously as a facility for scour prevention.

**Reference Signs List****[0041]**

|     |                       |
|-----|-----------------------|
| 10  | Scour prevention unit |
| 11  | Bag body              |
| 12  | Block objects         |
| 13  | Bag material          |
| 16  | Cloth                 |
| 18  | Fixing means          |
| 120 | Seabed                |

**REFERENCES CITED IN THE DESCRIPTION****Cited references**

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.

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- [JP2002121720A \[0002\] \[0010\]](#)
- [JP2015031148A \[0002\] \[0010\]](#)
- [KR20130051565A \[0007\]](#)
- [KR101320455B1 \[0008\]](#)

- US5951202A [0009]

**Patentkrav****1. Erosionsbeskyttelses- (10) enhed omfattende:**

- et sæklegeme (11) som rummer blokobjekter (12) i et sækmateriale (13);  
og  
5 et klæde (16) uden for sæklegemet (11) og fastgjort til en yderside af  
sæklegemet (11),  
hvor klædet er under blokobjekterne og fastgjort under sæklegemet uden  
for sæklegemet af mindst et fastgørelsesorgan,  
en kombination af sæklegemet, blokobjekterne og klædet er konfigureret til  
10 forhindre erosion af en havbund og passage af sandpartikler fra havbunden  
gennem sæklegemet, og  
fastgørelsesorganet omfatter en snøre forbundet med klædet og en krog  
forbundet med sæklegemet.

- 15 **2. Erosionsbeskyttelsesenheden (10) ifølge krav 1, hvor klædet (16) er et klæde, i**  
hvilket fibre af vævet stof, strikket stof (strikstof), knipling, filt eller ikke-vævet  
filt er bearbejdet til en tynd og bred bane.

**3. Erosionsbeskyttelses- (10) enhed ifølge krav 1 eller 2, omfattende:**

- 20 en flerhed af sæklegemer (11), som hver rummer blokobjekter (12) i et  
sækmateriale (13);  
hvor flerheden af sæklegemer (11) er placeret på klædet (16) tilstødende  
hinanden i en lateral retning, og  
klædet (16) er fastgjort under flerheden af sæklegemer (11) til ydersiden  
25 af flerheden af sæklegemer (11) via mindst et fastgørelsesorgan (18), idet  
fastgørelsesorganet omfatter en snøre forbundet med klædet og en krog  
forbundet med sæklegemet.

**4. Erosionsbeskyttelsesenhed (10) ifølge krav 3, hvor**

- 30 hver af flerheden af sæklegemer (11) er individuelt fastgjort til  
klædestykket (16) under anvendelse af fastgørelsesorgan (18), og/eller  
sæklegemerne (11) er forbundet i den laterale retning.

**5. Erosionsbeskyttelsesfremgangsmåde omfattende:**

et trin til at fremstille et sæklegeme, som rummer blokobjekter i et  
sækmateriale; og  
et trin til at integrere sæklegemet med klædet,  
hvor trinnet til at integrere sæklegemet med klædet inkluderer at fastgøre  
5 klædet under sæklegemet uden for sæklegemet via mindst et  
fastgørelsesorgan,  
en kombination af sæklegemet, blokobjekterne og klædet er konfigureret til  
at forhindre erosion af en havbund og passage af sandpartikler fra  
havbunden gennem sæklegemet, og  
10 fastgørelsesorganet omfatter en snøre forbundet til klædet og en krog  
forbundet til sæklegemet.

**6. Erosionsbeskyttelsesfremgangsmåde ifølge krav 5, omfattende:**

et trin til at fremstille en flerhed af sæklegemer (11), som rummer  
15 blokobjekter (12) i et sækmateriale (13); og  
et trin til at integrere flerheden af sæklegemer (11) med et klædestykke  
(16),  
hvor trinnet til at integrere sæklegemerne (11) med klædestykket (16)  
inkluderer at fastgøre klædestykket (16) under sæklegemerne (11) uden  
20 for sæklegemerne (11) via mindst et fastgørelsesorgan (18), idet  
fastgørelsesorganet omfatter en snøre forbundet til klædet og en krog  
forbundet til sæklegemet.

**7. Erosionsbeskyttelsesfremgangsmåde ifølge krav 6, yderligere omfattende**

25 et trin til at fastgøre hver af flerheden af sæklegemer (11) til klædestykket  
(16) individuelt under anvendelse af fastgørelsesorganet (18), og/eller  
et trin til at forbinde sæklegemerne (11) i den laterale retning forud for  
trinnet til at integrere sæklegemerne med klædestykket.

# DRAWINGS

FIG. 1

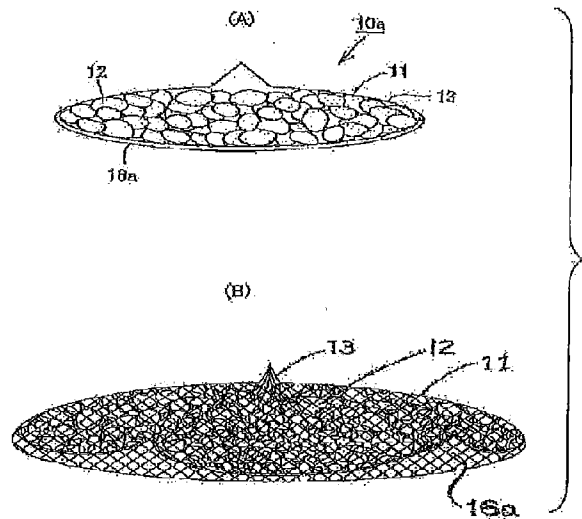


FIG. 2

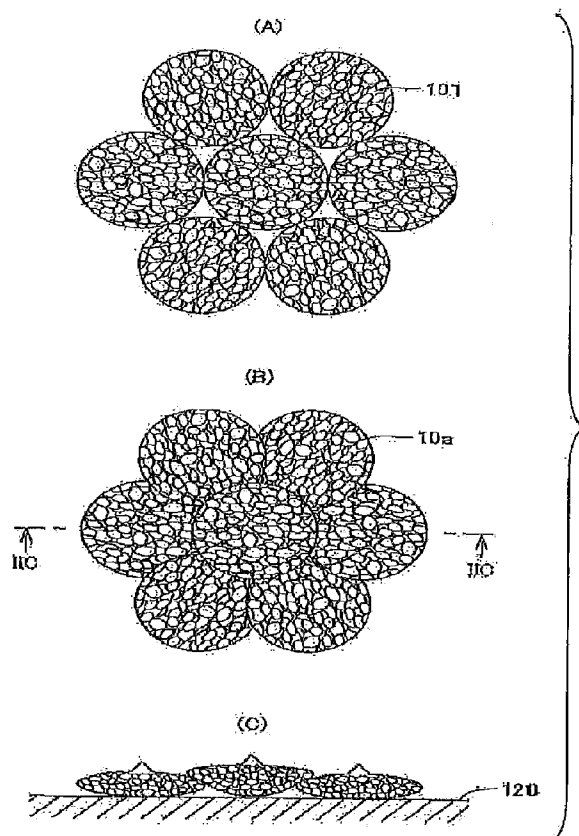


FIG. 3

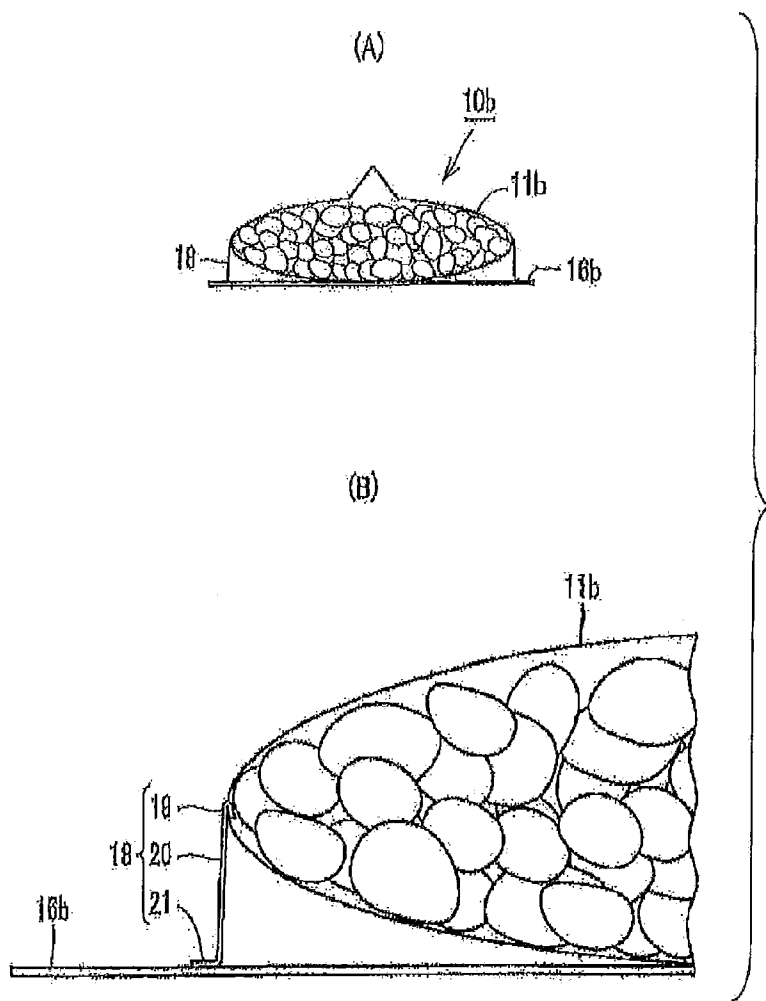


FIG. 4

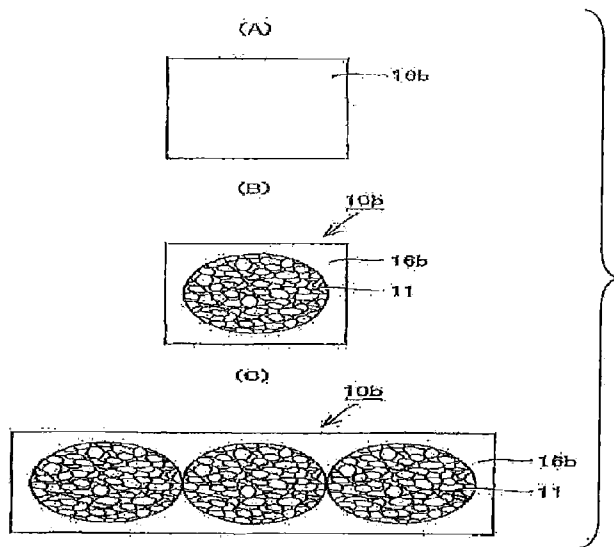


FIG. 5





FIG. 6

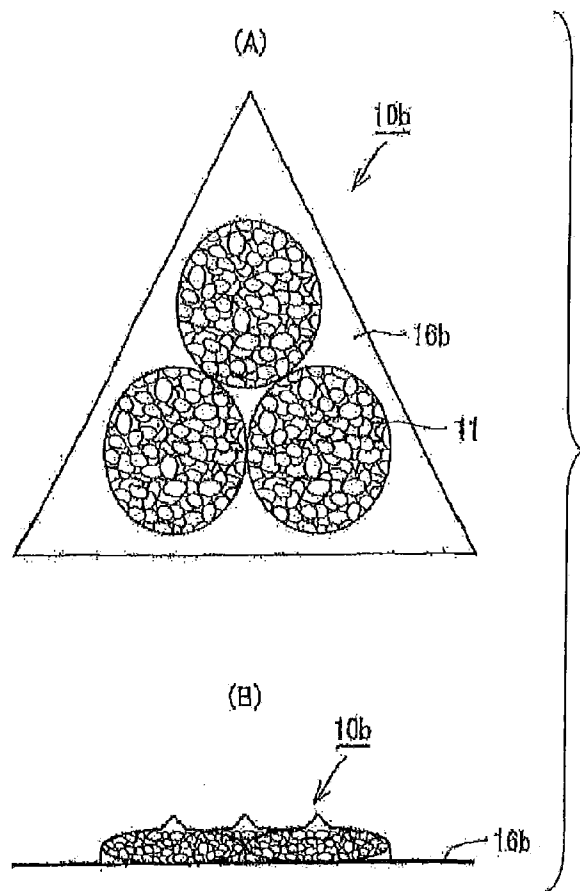


FIG. 7

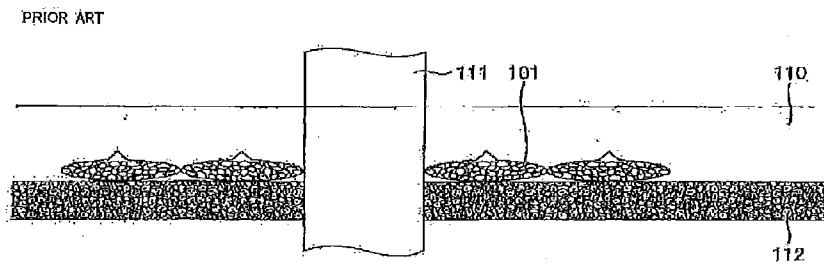


FIG. 8

PRIOR ART

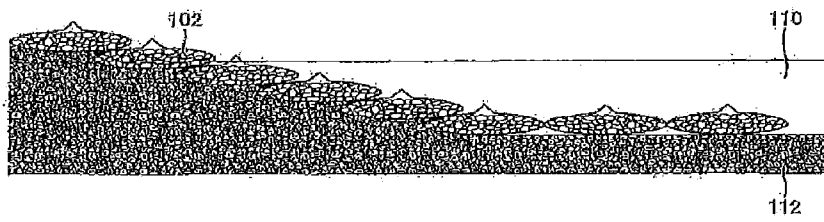


FIG. 9

PRIOR ART

