

Device for preventing turbid water for underwater soil improvement apparatus

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from Korean Patent Application No.
5 10-2012-0100310 filed on September 11, 2012 in the Korean Intellectual Property Office,
and all the benefits accruing therefrom under 35 U.S.C. 119, the contents of which in its
entirety are herein incorporated by reference.

BACKGROUND

10 1. Field of the Invention

The present invention relates to a device for preventing turbidity from water of an
underwater soil improving apparatus.

2. Description of the Related Art

In general, an underwater soil improving apparatus is used in improving soft
15 ground. The underwater soil improving apparatus includes an excavation rod for ground
improvement. In an example, an underwater soil improving apparatus includes an auger
machine (motor), a gear box coupled to the auger machine, and an excavation rod coupled
to the gear box. In order to increase excavation efficiency, the excavation rod includes an
excavation bit, excavation blades and agitation blades. In addition, a discharge hole is
20 formed at a bottom portion of the excavation rod to allow an improvement agent, such as
cement glue or mortar, to be inserted into the excavation rod to then be mixed and agitated
with excavated earth and sand.

In addition, in order to further increase the excavation efficiency, the excavation rod generally includes a plurality of excavation rods. Therefore, in order to stably support the plurality of excavation rods, a rod support stand for supporting the plurality of excavation rods is provided. Here, the rod support stand allows the excavation rod to rotate
5 therein while not being rotated.

Meanwhile, the ground improvement is done not only in an underground level but in an underwater level. That is to say, in order to construct a bridge, a pier or a building on the underwater ground, high-strength cylindrical or rectangular piles or coffering walls for waterproofing may first be constructed in the soft underwater ground for the purpose of
10 safely supporting props of the bridge, the pier or the building, and the bridge, the pier or the building may then be constructed on the piles or coffering walls.

However, environments in water, unlike on the ground, may be contaminated during improvement of the underwater ground. That is to say, if an improvement agent is injected into the underwater ground while excavating the underwater ground, floating soil
15 having the improvement agent and earth and sand mixed therein may float in water by a predetermined thickness. Since the improvement agent and the earth and sand contained in the floating soil are not yet cured, the floating soil is broken down into small pieces to then be extensively diffused in water. Therefore, during improvement of the underwater ground, water turbidity may be noticeably lowered by the floating soil and chemical components of
20 the improvement agent are extensively diffused, thereby contaminating the underwater environments.

In particular, since the chemical components of the improvement agent adversely affect marine organisms, damages may be caused to surrounding fish nursery areas. To

avoid this, it may be necessary to install a separate board for preventing turbidity of water around construction sites of the fish nursery areas.

Further, since the floating soil as a mixture of the improvement agent and the earth and sand has a low strength and is cured, it is necessary to separately remove the floating
5 soil after the improvement of the underwater ground.

SUMMARY

The present invention provides a device for preventing turbidity from water in an underwater soil improving apparatus due to floating soil during improvement of an
10 underwater soil.

The above and other objects of the present invention will be described in or be apparent from the following description of the preferred embodiments.

According to an aspect of the present invention, there is provided a device coupled to an excavation rod of an underwater soil improving apparatus for preventing turbidity
15 from water, the device including a body unit surrounding the excavation rod in a lengthwise direction of the excavation rod; a plurality of cover units coupled to an upper part of the body unit to allow the excavation rod to pass therethrough; a hinge unit connected between the body unit and the cover units and allowing the cover units to rotate in an upward, horizontal or downward direction; and an elasticity supply unit installed
20 between the body unit and the cover units and supply elasticity to the cover units to allow the cover units to be positioned in the horizontal direction.

Each of the cover units may further include a buoyancy tank installed therein to receive gas, liquid or solid having a smaller specific weight than water.

In addition, each of the cover units may further include a first cut-out portion formed to allow the excavation rod to pass therethrough.

The excavation rod may include a plurality of excavation rods, a support stand may be provided between each of the plurality of excavation rods in the same direction as a
5 lengthwise direction of the excavation rod, a support member coupling the plurality of excavation rods to the support stand may further be provided, and a second cut-out portion may further be formed in each of the cover units to allow the support stand to pass therethrough.

The excavation rod may be inserted into the body unit, the cover units may be
10 interfered by the support member to then be rotated such that ends of the cover units face down with respect to the hinge unit, and when the excavation rod is withdrawn from the body unit, the cover units may be interfered by the support member to then be rotated such that ends of the cover units face up with respect to the hinge unit.

After the excavation rod is inserted into the body unit or after the excavation rod is
15 withdrawn from the body unit, the cover units may be rotated by the elasticity supply unit such that ends of the cover units face horizontally with respect to the hinge unit.

A winch may be installed in the underwater soil improving apparatus, and a plurality of tow loops may be installed in the body unit to be coupled with tow wires of the winch.

20 As described above, one embodiment of the present invention provides a device for preventing turbidity due to floating soil from water in an underwater soil improving apparatus. That is to say, in the present invention, since the vicinity of the excavation rod is surrounded by the water turbidity preventing device, the floating soil may not be outwardly

diffused in vertical and horizontal directions. In other words, the floating soil is contained only within the body unit of the water turbidity preventing device but is not released to the outside of the body unit. Therefore, water turbidity is maintained as it is and diffusion of chemical components of the improvement agent is minimized, thereby preventing
5 underwater environments from being contaminated.

In particular, since marine organisms are not affected by the chemical components of the improvement agent, damages caused to surrounding fish nursery areas can be minimized, and it is not necessary to install a separate board for preventing turbidity of water for preventing seawater contamination.

10 Further, since the floating soil having the improvement agent and earth and sand mixed therein is cured within a predetermined area without being diffused, the floating soil has a high strength, unlike in the conventional art. That is to say, since the strength of the floating soil is similar to that of the improved underwater ground, a bridge, a pier or a building may be constructed directly on the underwater ground without separately
15 removing the floating soil.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the
20 attached drawings in which:

FIG. 1A is a plan view of a water turbidity preventing device for an underwater soil improving apparatus according to an embodiment of the present invention and FIG. 1B is a longitudinally sectional view of the water turbidity preventing device shown in FIG. 1A;

FIGS. 2A, 2B and 2C are partially sectional views illustrating states of cover units of the water turbidity preventing device shown in FIG. 1A; and

FIGS. 3A to 3J are views sequentially illustrating operations of the underwater soil improving apparatus including the water turbidity preventing device shown in FIG. 1A.

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DETAILED DESCRIPTION OF THE EMBODIMENTS

Hereinafter, an exemplary embodiment of the present invention will be described with reference to the accompanying drawings.

An exemplary embodiment will now be described more fully hereinafter with
10 reference to the accompanying drawings; however, they may be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey embodiments of the invention to those skilled in the art.

In the drawings, thicknesses of layers and regions may be exaggerated for clarity.
15 Like numbers refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

The terminology used herein is for the purpose of describing particular
embodiments and is not intended to be limiting of the invention. As used herein, singular forms are intended to include the plural forms as well, unless the context clearly indicates
20 otherwise. It will be further understood that the terms "comprises," and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of

one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

It will be understood that, although the terms first, second, etc., may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another element, component, region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

In addition, the term “water” used herein may mean both seawater and fresh water. Further, the terms “underwater soil improving apparatus” and “excavation rod installed therein” as used herein are provided only for exemplary illustration and may include concepts used for encompassing all of underwater soil improving apparatuses and excavation rods installed therein, although not illustrated herein. Therefore, the underwater soil improving apparatus and the excavation rod installed therein should be defined as defined herein.

FIG. 1A is a plan view of a water turbidity preventing device 100 for an underwater soil improving apparatus according to an embodiment of the present invention and FIG. 1B is a longitudinally sectional view of the water turbidity preventing device shown 100 in FIG. 1A.

As illustrated in FIGS. 1A and 1B, water turbidity preventing device 100 includes a body unit 110, a plurality of cover units 120, a hinge unit 130 and an elasticity supply unit 150.

The body unit 110 is configured to surround a predetermined region of the excavation rod (230 of FIG. 2A) along a lengthwise direction of the excavation rod. That is to say, the body unit 110 roughly surrounds the region of the excavation rod 230 by a predetermined length. Here, the body unit 110 is installed to be spaced a predetermined distance apart from the excavation rod 230 so as not to interfere with the operation of the excavation rod 230. For example, the body unit 110 may be substantially shaped of a rectangle having a central space in view of horizontal section. That is to say, the body unit 110 may be shaped of a rectangle having four sides coupled to each other at roughly right angle. Further, the body unit 110 may be substantially shaped of a hexahedron having four tetragonal, square or rectangular plates coupled to each other and top and bottom regions thereof opened, but the present invention does not limit the shape of the body unit 110 thereto. In particular, the horizontal section of the body unit 110 may be shaped of a triangle, a pentagon, a hexagon or a circle having a central space. In addition, as described above, the body unit 110 may be shaped to have a bottom portion opened to allow the excavation rod 230 to be easily inserted and withdrawn and to easily fill the floating soil during the ground improvement. Further, a tow loop 111 may be formed at opposite sides of the body unit 110 so as to be coupled to a tow wire (260 of FIG. 3A) installed in the underwater soil improving apparatus. The body unit 110 may be generally made of steel, plastic and equivalents thereof, but the present invention does not limit the material of the body unit 110 to those listed herein.

The cover unit 120 is coupled to the upper part of the body unit 110 and the excavation rod 230 passes through the cover unit 120. The cover unit 120 may include a plurality of cover units. In an example, the cover unit 120 may be coupled to four sides of

the body unit 110 one by one, providing four cover units 120 in total, but the present invention does not limit the number of the cover units 120 to four.

In more detail, each of the cover units 120 has a substantially triangular shape and one side thereof is rotatably coupled to each side of the body unit 110 by the hinge unit 130 to be described later. Here, first cut-out portions 121 are formed on the other two sides of the cover units 120 to allow the excavation rod 230 to pass therethrough. Two first cut-out portions 121 of the neighboring cover units 120 are installed to face each other, so that the two first cut-out portions 121 provide a substantially circular shape. Therefore, the excavation rod 230 passes through a space formed by the two first cut-out portions 121.

In addition, the respective cover units 120 have second cut-out portions 122 formed at vertexes facing the sides thereof coupled to the body unit 110. The second cut-out portions 122 formed on four neighboring cover units 120 are installed to face each other, so that four second cut-out portions 122 provide a substantially tetragonal shape. Therefore, a support stand (240 of FIG. 2B) and a support member (250 of FIG. 2B) to be described later may pass through a space formed by the four second cut-out portions 122.

Meanwhile, each of the cover units 120 may further include a buoyancy tank 123 installed therein to receive gas (air), liquid and/or solid having a smaller specific weight than water. That is to say, as illustrated in FIG. 1B, each of the cover units 120 may have a planar top section and a triangular bottom section having vertexes, and the buoyancy tank 123 may have a triangular interior portion. That is to say, the (air), liquid and/or solid having a smaller specific weight than water is received in the triangular interior portion of the buoyancy tank 123. Therefore, each of the cover units 120 basically tends to float in water. In addition, the elasticity supply unit 150 to be described later provides an upward

elastic force from one side of each of the cover units 120, so that each of the cover units 120 basically tends to be horizontally positioned. Therefore, the water turbidity preventing device 100 according to the present invention basically has a property of not being reversed or overturned in water.

5 However, in some case, the respective cover units 120 may be configured such that opposite ends thereof face down or up with respect to the hinge unit 130, which will further be described below.

 The hinge unit 130 is connected between the body unit 110 and the cover units 120 and allows the cover units 120 to rotate in upward, horizontal and/or downward directions
10 by a predetermined angle. In addition, the hinge unit 130 may prevent the cover units 120 from being separated from the body unit 110. In an example, the hinge unit 130 may include three hinge units for each of the cover units 120, but the present invention does not limit the number of hinge units to that exemplified herein.

 The elasticity supply unit 150 is installed between the body unit 110 and the cover
15 units 120 and allows the cover units 120 to be horizontally positioned. For example, the elasticity supply unit 150 is located to correspond to the centrally positioned one of three hinge units 130 installed in each of the cover units 120.

 In more detail, the elasticity supply unit 150 includes a body support unit 151 installed in the body unit 110, a cover support unit 152 installed in the cover unit 120 and a
20 spring 153 installed between the body support unit 151 and the cover support unit 152. Here, the spring 153 may be modified into another kind of elastic member. In addition, the spring 153 may be shaped or may be set to have an elastic force to allow the cover units 120 to be horizontally positioned. Therefore, the cover units 120 basically tend to be

horizontally positioned.

Referring to FIGS. 2A, 2B and 2C, partially sectional views illustrating states of cover units (120) of the water turbidity preventing device (100) shown in FIG. 1A are illustrated.

5 As illustrated in FIGS. 2A to 2C, the excavation rod 230 includes a plurality of excavation rods and a support stand 240 is provided between each of the plurality of excavation rods 230 in the same direction as lengthwise directions of the excavation rods 230. A support member 250 for coupling the plurality of excavation rods 230 to the support stand 240 is further provided. As described above, the second cut-out portions (122 of FIG. 10 1A) are further formed in the cover units 120 to allow the support stand 240 and the support member 250 to pass therethrough.

First, as illustrated in FIG. 2A, the cover units 120 of the water turbidity preventing device 100 are basically positioned in the horizontal direction by means of the elasticity supply unit 150. That is to say, the cover units 120 are positioned to be perpendicular to the 15 lengthwise directions of the excavation rods 230, which occurs before or after the support stand 240 and the support member 250 supporting the excavation rods 230 pass through the cover units 120. Here, the cover units 120 do not interfere with the support stand 240 and the support member 250.

As illustrated in FIG. 2B, the cover units 120 of the water turbidity preventing 20 device 100 may rotate by a predetermined angle such that the ends thereof face down with respect to the hinge unit 130. This state occurs when the support stand 240 and the support member 250 supporting the excavation rod 230 pass through the cover units 120 to then be downwardly inserted into the body unit 110. That is to say, the cover units 120 interfere

with the downwardly moving support member 250, so that the ends of the cover units 120 face down.

As illustrated in FIG. 2C, the cover units 120 of the water turbidity preventing device 100 may rotate by a predetermined angle such that the ends thereof face up with respect to the hinge unit 130. This state occurs when the support stand 240 and the support member 250 supporting the excavation rod 230 pass through the cover units 120 to then be upwardly withdrawn from the body unit 110. That is to say, the cover units 120 interfere with the downwardly moving support member 250, so that the ends of the cover units 120 face up.

Referring to FIGS. 3A to 3J, operations of the underwater soil improving apparatus (200) including the water turbidity preventing device (100) shown in FIG. 1A are sequentially illustrated.

As illustrated in FIGS. 3A to 3J, the underwater soil improving apparatus 200 includes an auger machine (motor) 210, a gear box 220 coupled to the auger machine 210, and a plurality of excavation rods 230 coupled to the gear box 220. Here, in order to increase excavation efficiency, each of the excavation rods 230 may include an excavation bit 231, excavation blades 232 and agitation blades 233. In addition, a discharge hole (not shown) is formed at a bottom portion of each of the excavation rods 230 to allow an improvement agent, such as cement glue or mortar, to be inserted into the excavation rod to then be mixed and agitated with excavated earth and sand.

In addition, a support stand 240 extending from the gear box 220 in the same direction as the excavation rods 230 is installed between each of the plurality of excavation rods 230, and one or more support members may be installed between the support stand

240 and the excavation rods 230. As shown, among the one or more support members, the support member installed at a lower portion may be defined as a first support member 251 and the support member installed at an upper portion may be defined as a second support member 252.

5 As illustrated in FIG. 3A, a tow wire 260 is connected to a tow loop 111 provided in the body unit 110 of the water turbidity preventing device 100, and the tow wire 260 is coupled to a winch (not shown) provided in the underwater soil improving apparatus 200. Therefore, the water turbidity preventing device 100 may be upward elevated or downward lowered together with the underwater soil improving apparatus 200. In addition, the water
10 turbidity preventing device 100 is initially configured to cover a bottom end of the underwater soil improving apparatus 200, that is, substantially lower portions of the excavation rods 230 and is downward lowered into underwater together with the excavation rods 230. Here, since the cover units 120 of the water turbidity preventing device 100 interfere with none of components of the water turbidity preventing device 100,
15 they are maintained at a substantially horizontal (parallel) state.

 As illustrated in FIG. 3B, the ends of the excavation rods 230 and the water turbidity preventing device 100 are lowered together until they reach the ground surface. If the ends of the excavation rods 230 and the water turbidity preventing device 100 reach the ground surface, the winch lowering the water turbidity preventing device 100 stops
20 operating. Therefore, a predetermined tension is applied to the tow wire 260 provided between the water turbidity preventing device 100 and the winch. In addition, since a buoyancy tank is installed in the water turbidity preventing device 100, the water turbidity preventing device 110 may not be reversed or overturned.

As illustrated in FIG. 3C, if the auger machine (motor) 210 operates, a ground improvement operation may be performed by own weights of the plurality of excavation rods 230 during rotation of the plurality of excavation rods 230. That is to say, an improvement agent, such as cement glue or mortar, is inserted into the underground to then
5 be mixed and agitated with excavated earth and sand.

Meanwhile, the excavation rods 230 move downwardly into the underground due to rotation of the excavation rods 230. Here, the support stand 240 and the first support member 251 also move downwardly. Therefore, since the first support member 251 interferes with the cover units 120 of the water turbidity preventing device 100 and the first
10 support member 251 moves downwardly, the ends of the cover units 120 may face substantially down with respect to the hinge unit 150.

As illustrated in FIG. 3D, if the first support member 251 is completely lowered toward the inside of the body unit 110, it does not interfere with the cover units 120. Therefore, the cover units 120 are maintained at a horizontal state by functions of the
15 buoyancy tank 123 and the elasticity supply unit 150 installed inside the cover units 120.

In addition, as the ground improvement operation is progressed, the floating soil 300 may float to the outside of the ground surface. However, in the present invention, since the water turbidity preventing device 100 surrounds regions around the excavation rods 230, the floating soil 300 may not be diffused in a horizontally outward direction. That is to
20 say, the floating soil 300 is accommodated only within the body unit 110 of the water turbidity preventing device 100 but is not released to the outside of the body unit 110. Therefore, according to the present invention, since the floating soil 300 is contained within the water turbidity preventing device 100, water turbidity is maintained as it is and

diffusion of chemical components of the improvement agent is minimized, thereby preventing underwater environments from being contaminated. In particular, since marine organisms are not affected by the chemical components of the improvement agent, damages caused to surrounding fish nursery areas can be minimized, and it is not necessary
5 to install a separate board for preventing turbidity of water for preventing seawater contamination.

Further, since the floating soil 300 in the water turbidity preventing device 100 is cured within a predetermined area without being diffused, the floating soil 300 has a high strength, unlike in the conventional art. That is to say, since the strength of the floating soil
10 300 is similar to that of the improved underwater ground, a bridge, a pier or a building can be constructed directly on the underwater ground without separately removing the floating soil 300.

As illustrated in FIG. 3E, if the ground improvement operation is continuously performed, the second support member 252 interferes with the cover units 120. Therefore,
15 since the second support member 252 moves downwardly, the cover units 120 are rotated such that the ends thereof may face substantially down with respect to the hinge unit 130.

As illustrated in FIG. 3F, if the second support member 252 is completely lowered toward the inside of the body unit 110, it does not interfere with the cover units 120. Therefore, the cover units 120 are maintained at a horizontal state by functions of the
20 buoyancy tank 123 and the elasticity supply unit 150 installed inside the cover units 120. Here, the floating soil 300 is still contained only within the water turbidity preventing device 100, thereby minimizing environmental contamination.

As illustrated in FIG. 3G, if the ground improvement operation is completed, the

excavation rods 230 are elevated. Here, the second support member 252 interferes with the cover units 120, so that the ends of the cover units 120 may face substantially up with respect to the hinge unit 130. Here, since the excavation rods 230 are slowly elevated while rotating, an agitation operation is still performed.

5 As illustrated in FIG. 3H, if the second support member 252 is withdrawn from the water turbidity preventing device 100, it does not interfere with the cover units 120, so that the cover units 120 may be maintained at a substantially horizontal state.

 As illustrated in FIG. 3I, if the excavation rods 230 are continuously elevated, the first support member 251 interferes with the cover units 120, so that the ends of the cover
10 units 120 may face substantially up with respect to the hinge unit 130. Here, since the excavation rods 230 are slowly elevated while rotating, the agitation operation is still performed.

 As illustrated in FIG. 3J, if the ground improvement operation is completed, the winch operates at the same when the excavation rods 230 are elevated, and the water
15 turbidity preventing device 100 is also elevated with the excavation rods 230.

 Accordingly, the floating soil 300 in the water turbidity preventing device 100 is finally exposed to above the underwater ground, but the ground improvement operation is completed so that external shocks are not applied to the floating soil 300, thereby minimizing environmental contamination due to the floating soil 300.

20 While the water turbidity preventing device of an underwater soil improving apparatus according to the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein

without departing from the spirit and scope of the present invention as defined by the following claims. It is therefore desired that the present embodiments be considered in all respects as illustrative and not restrictive, reference being made to the appended claims rather than the foregoing description to indicate the scope of the invention.

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Brief explanation of essential parts of the drawings

100: Water turbidity preventing device of underwater soil improving apparatus

110: Body unit

111: Tow loop

120: Cover units

121: First cut-out portion

10 122: Second cut-out portion

123: Buoyancy tank

130: Hinge unit

150: Elasticity supply unit

151: Body support unit

152: Cover support unit

153: Spring

200: Underwater soil improving apparatus

210: Auger machine

220: Gear box

15 230: Excavation rod

231: Excavation bit

232: Excavation blade

233: Agitation blade

240: Support stand

250: Support member

260: Tow wire

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WHAT IS CLAIMED IS:

1. A device coupled to an excavation rod of an underwater soil improving apparatus for preventing turbidity from water, the device comprising:

5 a body unit surrounding the excavation rod in a lengthwise direction of the excavation rod;

 a plurality of cover units coupled to an upper part of the body unit to allow the excavation rod to pass therethrough;

 a hinge unit connected between the body unit and the cover units and allowing the
10 cover units to rotate in an upward, horizontal or downward direction; and

 an elasticity supply unit installed between the body unit and the cover units and supply elasticity to the cover units to allow the cover units to be positioned in the horizontal direction.

15 2. The device of claim 1, wherein each of the cover units further includes a buoyancy tank installed therein to receive gas, liquid or solid having a smaller specific weight than water.

 3. The device of claim 1, wherein each of the cover units further includes a first
20 cut-out portion formed to allow the excavation rod to pass therethrough.

 4. The device of claim 1, wherein the excavation rod includes a plurality of excavation rods, a support stand is provided between each of the plurality of excavation

rods in the same direction as a lengthwise direction of the excavation rod, a support member coupling the plurality of excavation rods to the support stand is further provided, and a second cut-out portion is further formed in each of the cover units to allow the support stand to pass therethrough.

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5. The device of claim 4, wherein when the excavation rod is inserted into the body unit, the cover units are interfered by the support member to then be rotated such that ends of the cover units face down with respect to the hinge unit, and when the excavation rod is withdrawn from the body unit, the cover units are interfered by the support member
10 to then be rotated such that ends of the cover units face up with respect to the hinge unit.

6. The device of claim 4, wherein after the excavation rod is inserted into the body unit or after the excavation rod is withdrawn from the body unit, the cover units are rotated by the elasticity supply unit such that ends of the cover units face horizontally with
15 respect to the hinge unit.

7. The device of claim 1, wherein a winch is installed in the underwater soil improving apparatus, and a plurality of tow loops are installed in the body unit to be coupled with tow wires of the winch.

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