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 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 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 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 ends of the 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.

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 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, an upper surface of the cover units may be 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be rotated such that ends of the cover units face down with respect to the hinge unit, and when the excavation rod is withdrawn from the body unit, a lower surface of the cover units may be interfered by the support member to then be rotated such that ends of the cover units face up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 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.

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

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.

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 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 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 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.

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. 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 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 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, an upper surface of the cover

units 120 interferes 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, a lower surface of the cover units 120 interferes with the ~~downwardly~~ upwardly 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

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 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 upper surface of the cover units 120 of the water turbidity preventing device 100 and the first 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 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 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 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 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 upper surface of the cover units 120. Therefore, 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 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 lower surface of 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.

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 lower surface of 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, 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 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.

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

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:

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 ends of the 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.

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 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.

5. The device of claim 4, wherein when the excavation rod is inserted into the body unit, an upper surface of 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, a lower surface of the cover units are interfered by the support member 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 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.