

METHOD AND APPARATUS FOR SINKING BAGGED SOIL

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to a method and an apparatus for sinking a bagged soil when an embankment is constructed at a water-bottom of a dam, a lake or the like and a sea-bottom.

10 2. Prior Art

In a prior art, in order to construct a submarine embankment at a water-bottom of a dam, a lake or the like and a sea-bottom, as shown in Fig.18, a bag 48 filled with soil or the like, that is, a bagged soil 49 is cast to pile up on a water-bottom 50. The bagged soil 49 is cast to the water-bottom 50 from a vicinity of a water surface 51. Further, as other method for sinking a
15 bagged soil, there is known the invention disclosed in WO8803583.

However, the bagged soil is cast to the water-bottom from the water surface vicinity, and therefore, the bagged soil cannot accurately be cast to a portion to be sunk therewith. Further, when cast from the water surface vicinity, in getting down to the bottom, an unreasonable force is applied to the bag and there is a concern of breaking the bag.

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SUMMARY OF THE INVENTION

The invention has been accomplished in view of the above-described problem and it is an object thereof to provide a method and an apparatus for sinking a bagged soil capable of being cast accurately to a portion to be sunk without applying an excessive force to a bag.

25 In order to resolve the above-described problem, a method for sinking a bagged soil of the invention is comprised of steps of: containing a sinking bucket guided with guide legs to move up and down at an opening formed in a pontoon and penetrated to a water surface, sinking into water a bag carried on the sinking bucket and filling the bag with soil under the water surface, sinking the sinking bucket with being guided by the guide legs, thereafter, opening a bottom plate
30 of the sinking bucket and dropping the bag.

The bag may have a plurality of soil filling ports and the soil is uniformly filled into the bag from the filling ports.

The sinking bucket is moved up or down by reeling out or winding back a lifting wire from a lifting winch connected to the sinking bucket and an opening/closing wire from an

opening/closing winch connected to the bottom plate of the sinking bucket and the bottom plate is opened/closed by reeling out or winding back the opening/closing wire from the opening/closing winch.

Further, the bottom plate may be opened by reeling out the opening/closing wire from
 5 the opening/closing winch after sinking the sinking bucket into water to stop at a predetermined depth by reeling out the lifting wire and the opening/closing wire, or the bottom plate is opened by pulling up the sinking bucket by winding back only the lifting wire.

Furthermore, the bottom plate may be opened by sinking the sinking bucket into water by reeling out the lifting wire and the opening/closing wire until getting down to a water-bottom,
 10 thereafter, pulling up the sinking bucket by winding back only the lifting wire.

Further, a method for sinking a bagged soil of the invention is comprised of steps of: containing a hanging frame member guided with guide legs to move up and down at an opening formed in a pontoon and penetrated to a water surface, hanging a bag by grab pieces provided with the hanging frame member, sinking into water the bags and filling the bags with soil under
 15 the water surface, thereafter, sinking the hanging frame member with being guided by the guide legs until the bag is got down to a water-bottom, thereafter, releasing the bags from the grab pieces. The bag may have a plurality of soil filling ports and the soil is uniformly filled into the bag from the filling ports in this method.

The above method of the invention can be performed with use of an apparatus that is
 20 comprised of a pontoon having an opening penetrated to a water surface, a sinking bucket contained in the opening and having at least a bottom plate being able to open and close, guide legs that guides for the sinking bucket to move up and down, wherein the sinking bucket is connected with a lifting wire from a lifting winch provided on the pontoon, and also the bottom plate of the sinking bucket is connected with an opening/closing wire from an opening/closing
 25 winch. The pontoon may be constituted by integrating two pontoons in double barrels to be able to form the opening.

An another apparatus may be used for the method, which is comprised of a pontoon having an opening penetrated to a water surface, a sinking bucket contained in the opening and having at least a bottom plate being able to open and close, guide legs that guides for the sinking
 30 bucket to move up and down, wherein the sinking bucket is connected with a lifting wire from a lifting winch provided on the pontoon, and also the bottom plate of the sinking bucket is connected with an opening/closing wire from an opening/closing winch by way of a front end of a cylinder rod of a hydraulic cylinder installed at the sinking bucket, and the bottom plate is opened/closed by extracting and retracting the cylinder rod. The pontoon may be constituted by integrating two

pontoons in double barrels to be able to form the opening.

Further, an another apparatus may be used for the method, which is comprised of a pontoon having an opening penetrated to a water surface, a hanging frame member contained in the opening, guide legs that guides for the hanging frame member to move up and down, wherein the hanging frame member is connected with a lifting wire from a lifting winch provided on the pontoon, and a plurality of grab pieces are installed at the hanging frame member. A plurality of the grab pieces may be summarized into one to constitute a unit. Further, the pontoon may be constituted by integrating two pontoons in double barrels to be able to form the opening.

According to the present invention, the bag is sunk with being guided by the guide legs, and therefore, the bag can accurately be sunk to a portion to be sunk therewith even at a sea region having a tide. Further, the bottom plate of the sinking bucket is opened by bringing it to the sea-bottom, and therefore, a height of dropping the bag can be reduced and the danger of destructing the bag can be reduced.

Further, the soil is filled to the bag under the water surface, and therefore, a load to the sinking bucket can be reduced due to action of buoyancy to the bag and lifting equipment can be reduced. Furthermore, the sinking bucket and the hanging frame member can be pulled up into the atmosphere, and therefore, maintenance thereof can easily be carried out.

By uniformly filling the soil from the plurality of soil filling ports into the bag, an excessive force is not applied to the bag, a load to the lifting equipment of the sinking bucket or the like is averaged and an excessively uneven load is not applied thereto in view of the structure. Further, the sinking bucket is lifted and the bottom plate is opened/closed by the lifting winch and the opening/closing winch, and therefore, the lifting apparatus becomes concise in view of a mechanism thereof.

The height of dropping the bag can further be reduced by sinking the sinking bucket into water by reeling out the lifting wire and the opening/closing wire until getting down to the water-bottom, thereafter, opening the bottom plate by pulling up the sinking bucket by winding back only the lifting wire. Further, by sinking the hanging frame member with being guided by the guide legs until the bag is got down to the water-bottom, thereafter, releasing the bags from the grab pieces, it is not necessary to drop the bag, the danger of destructing the bag is eliminated at all and also the sinking position becomes accurate.

Furthermore, by installing a plurality of grab pieces on a lower side of the hanging frame member moved up and down with being guided by the guide leg, the lifting equipment can be made to be concise and light-weighted.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a plan view showing a sinking apparatus according to a first embodiment of the invention;

5 Fig.2 is a perspective view showing an essential portion of the sinking apparatus;

Figs.3A and 3B are a plane view and a vertical sectional view showing a sinking bucket of the sinking apparatus, respectively;

Fig.4 is a side view showing the sinking apparatus in a state of sinking the sinking bucket;

10 Fig.5 is a front view showing the sinking apparatus in the state of sinking the sinking bucket;

Fig.6 illustrates a method how to drop a bag using the sinking bucket;

Fig.7 illustrates another method how to drop a bag using the sinking bucket;

15 Figs.8A and 8B are a front view showing a close state of a sinking bucket of a sinking apparatus according to a second embodiment and a front view showing an open state thereof, respectively;

Figs.9A and 9B are a front view showing a close state of a sinking bucket of a sinking apparatus according to a third embodiment and a front view showing an open state thereof;

Fig.10 is a front view showing a sinking apparatus according to a fourth embodiment;

20 Fig.11A is a plan view showing a hanging frame member of the sinking apparatus, and Figs.11B, 11C and 11D are a plan view, a side view showing a grab clamp of the hanging frame member, respectively, and a side view showing a state of the grab clamp released from a grab strip;

Fig.12 illustrates a method how to drop a bag using the hanging frame member;

25 Fig.13 illustrates another method how to drop a bag using the hanging frame member;

Fig.14A is a plan view showing a hanging frame member of a sinking apparatus according to a fifth embodiment, and Figs.14B and 14C are a plan view and a side view showing a grab clamp of the hanging frame member;

Fig.15 is a side view showing a submarine embankment constructed at a sea-bottom;

30 Fig.16 is a plan view showing a sinking apparatus according to a sixth embodiment;

Fig.17A is a front view showing the sinking apparatus, and Fig.17B is a sectional view showing a state of using a sinking bucket in the sinking apparatus; and

Fig.18 is a sectional view showing a sinking method in prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A detailed explanation will be given of embodiments of a method and an apparatus for sinking a bagged soil of the invention referring to the accompanying drawings as follows. First, an apparatus for sinking a bagged soil (hereinafter, referred to as sinking apparatus) will be explained, next, a method for sinking a bagged soil (hereinafter, referred to as sinking method) using the sinking apparatus will be explained. Same constituent elements as those of respective embodiments will be explained by assigning the same numerals and only constituent elements will be explained by assigning different numerals thereto.

Fig.1 through Fig.7 show a sinking apparatus 1 according to a first embodiment of the invention. The sinking apparatus 1 is comprised of a pontoon 2 (for example, about 44 × 55 m) having an opening 3 (for example, about 14 × 34 m) in a rectangular shape in a plan view penetrated to a water surface at a center portion of the pontoon 2 and a sinking bucket 4 (for example, about 12 × 32 m) contained at the opening portion 3. The pontoon 2 is towed to a predetermined portion by a towboat and positioned at a portion to sink bags by reeling out or winding back ship operating wires 20 from ship operating winches 18.

The sinking bucket 4 is constituted by a frame member 5 having a size capable of being contained in the opening portion 3, two sheets of bottom plates 6 which open and close at the center portion thereof, and guide legs 7 (leg columns of lifting guides) erected at four corners of an upper face of the frame member 5. These four guide legs 7 are supported with capable of ascending and descending by support legs 8 installed on decks on both sides of the opening portion 3. The support legs 8 have upper plates 9 and lower plates 9a, through which the guide legs 7 ascend and descend with being guided. Thus, the sinking bucket 4 is supported at the support legs 8 through the guide legs 7. Further, the guide legs 7 cannot be limited to four pieces thereof.

Further, short sides of the frame member 5 of the sinking bucket 4 are brought into a state of being hung down by lifting wires 11 of a pair of lifting winches 10 installed on decks rearward from the support legs 8. One end of the lifting wire 11 is fixed to the support leg 8 by way of two pulleys 12 at an upper face of the support leg 8 and a pulley 12 at an upper face of the side of the short side of the frame member 5.

On the other hand, also two sheets of the bottom plates 6 installed at the lower face of the frame member 5 of the sinking bucket 4 are connected with opening/closing wires 14 from opening/closing winches 13. Further, one end of the opening/closing wire 14 from an opening/closing winch 13 installed contiguous to the lifting winch 10 is fixed to the support leg 8 by

way of two pulleys 12 at the upper face of the support leg 8 and the pulley 12 of a connecting plate 16 of the opening/closing arm 15. Further, the bottom plates 6 are not limited to two sheets thereof but may be constituted by one sheet plate.

Further, front ends of two opening/closing arms 15 rotatably installed in the connecting plate 16 are rotatably installed at front-end portions of the bottom plates 6. The opening/closing arms 15 are disposed on sides of short sides at inside of the frame member 5, and connected to both sides of two sheets of the bottom plates 6, respectively. Therefore, when the opening/closing arms 15 are moved up and down, the respective bottom plate 6 be rotated centering on a hinge 17 to open from a center portion. That is, when the opening/closing arms 15 are moved down, the bottom plates 6 are opened bidirectionally and when the opening/closing arms 15 are pulled up from the opened state, the bottom plates 6 are closed.

Therefore, the sinking bucket 4 is moved up and down by reeling out or winding back the lifting wires 11 and the opening/closing wires 14 with being guided by the guide legs 7. For example, as shown by Fig.6, by reeling out the lifting wires 11 from the lifting winches 10 and reeling out the opening/closing wires 14 from the opening/closing winches 13, the sinking bucket 4 is sunk into water with being guided by the guide legs 7, and when the lifting wires 11 and the opening/closing wires 14 are stopped from being reeled out at a location reaching a predetermined depth, the sinking bucket 4 is stopped from sinking (refer to (A) of Fig.6). Further, when a predetermined amount of the opening/closing wire 14 is reeled out from the opening/closing winch 13, the bottom plate 6 is rotated centering on the hinge 17 by its own weight to open from a center portion (refer to (B) and (C) of Fig.6).

Further, otherwise, when the lifting wires 11 and the opening/closing wires 14 are stopped from reeling out, the sinking bucket 4 is stopped from being sunk, thereafter, only the sinking bucket 4 is moved up from the state, there is brought about a state of reeling out a predetermined amount of the opening/closing wires 14, and therefore, the bottom plates 6 are rotated centering on the hinges 17 to open from the center portion.

On the other hand, as shown by Fig.7, the sinking bucket 4 is sunk in water with being guided by the guide legs 7 by reeling out the lifting wires 11 from the lifting winches 10 and the opening/closing wires 14 and the lifting wires 11 and the opening/closing wires 14 are stopped from reeling out when get down to the water bottom (the lifting winches 10 and the opening/closing winches 13 are brought into a stopped state/refer to (A) in Fig.7). Next, when only the lifting wires 11 are wound back to the lifting winches 10, the sinking bucket 4 is moved up, and the opening/closing winches 13 are made to stay in the stopped state, there is brought about a state of reeling out a predetermined amount of the opening/closing wires 14, and therefore, the

bottom plates 6 are rotated centering on the hinges 17 to open from the center portion (refer to (B) and (C) in Fig.7).

Such an operation of the lifting winch 10, the opening/closing winch 13 and the ship operating winch 18 and the like is carried out by remote operation from an operating/controlling chamber 19. Additionally, at the operating/controlling chamber 19, an operation of filling soil to a bag installed at the sinking bucket 4 is also carried out.

Further, the sinking apparatus 1 is installed with a depth meter of the sinking bucket by an amount of reeling out the wire from the winch, a load meter installed at an end portion of the wire, a lifting load meter by a motor load, an apparatus for measuring a depth of a sea-bottom and a ground by an acoustic depth measuring machine and a GPS position measuring apparatus, a ship body position measuring system by a GPS apparatus and the like, although not illustrated.

Further, Figs.8A and 8B show a sinking apparatus 21A according to a second embodiment of the invention. In the sinking apparatus 21A, the bottom plates 6 of the sinking bucket 4 are opened/closed by hydraulic cylinders 22, and other portions are constructed as same as that of the sinking apparatus 1 according to the first embodiment.

As shown in Figs.8A and 8B, the sinking apparatus 21A has two hydraulic cylinders 22 installed at both end portions on the short sides of the frame member 5 of the sinking bucket 4 (four cylinders in total) to be inclined to an inner side and directing upward, and the opening/closing wires 14 are caught by cylinder rods 23 of the respective hydraulic cylinders 22. That is, one end portions of the opening/closing wires 14 are fixed to the upper face of the frame member 5 and other end portions thereof are fixed to a front end side (center portion side) of the bottom plate 6 by way of the pulleys 12 at front ends of the cylinder rods.

Therefore, as shown in Fig.8A, when the cylinder rods 23 are extracted, the bottom plates 6 are closed and when the cylinder rods 23 are retracted, center portions of the bottom plate 6 are rotated by their own weights centering on the hinges 17 to open the center portions of the bottom plates 6. In this way, the bottom plates 6 are opened and closed by extracting and retracting the cylinder rods 23 of the hydraulic cylinders, and are not opened and closed by the opening/closing wires 14 from the opening/closing winches 13 as described above.

Further, Figs.9A and 9B show a sinking apparatus 21B according to a third embodiment of the invention, in which one hydraulic cylinder 22 is installed at the center portion on the side of the short side of the frame member 5 of the sinking bucket 4 (two cylinders in total) directing to a lower side, and the opening/closing wires 14 are caught by the cylinder rods 23. That is, one end portion of the opening/closing wire 14 is fixed to a front end side (center side) of the bottom plate 6 on one side, and other end portion thereof is fixed to a front end portion of the bottom plate

6 on other side by way of the pulley 12 at the front end of the cylinder rod.

Therefore, as shown by Fig.9A, when the cylinder rod 23 is contracted, the bottom plates 6 are closed, and when the cylinder rod 23 is extracted, the bottom plates 6 are rotated (by its own weight) centering on the hinge 17 to open the center portion of the bottom plates 6, thus
 5 open and close of the bottom plates 6 are carried out by extracting and retracting the cylinder rod 23. Further, also the operations of extracting and contracting the hydraulic cylinder 22 are carried out by a remote operation from the operating/controlling chamber 19.

Further, Fig.10 through Fig.13 show a sinking apparatus 25 according to a fourth embodiment. As shown by Fig.10, the sinking apparatus 25 is provided with a plurality of grab
 10 clamps 27 constituting grab pieces at a hanging frame member 26 made by removing the bottom plates 6 from the frame member 5 of the sinking bucket 4. Other portions are constructed as same as that of the sinking apparatus 1 according to the first embodiment. In this sinking apparatus 25, a bag 28 is hung down from the hanging frame member 26 by the plurality of grab clamps 27 to be dropped to a sea-bottom 41.

As shown by Fig.11A, the grab clamp 27 is hung down by hang down wires 29 (14 pieces on one side and a total of 28 pieces) hung down from lower faces on sides of long sides of the hanging frame member 26 in order to grab both sides of the bag 28. Further, as shown in Figs.11B through 11D, the grab clamp 27 is constituted by installing a movable pin 31 at a clamp
 15 30 in a channel-like shape, and the pin 31 is inserted into an inserting hole 33 of a grab strip 32 of the bag.
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Although when the bag 28 is grabbed, an operator manually inserts the pin 31 into the inserting hole 33 of the grab strip 32, drawing of the pin 31 from the inserting hole 33 is automatically carried out by a remote operation from the operating/controlling chamber 19. Further, a number of the grab clamps 27 is not limited to the above described but an arbitrarily
 25 selected and also the grab piece is not limited to the grab clamp.

Further, Fig.14A through Fig.14C show a sinking apparatus 35 according to a fifth embodiment. As shown by the drawings, the sinking apparatus 35 summarizes the plurality of grab clamps 27 into ones to constitute 3 pieces of units 36 on side of one side, and the other constituent elements are same as that of the sinking apparatus 25 according to the fourth
 30 embodiment. At both ends of 3 pieces of the units 36, 5 pieces of the grab clamps 27 are summarized to one, and at center portions thereof, 4 pieces of the grab clamps 27 are summarized to one. Such summarizing of the plurality of grab clamps 27 into one unit 36 facilitates its handling, and therefore, attachment and detachment of the clamp 27 are simplified. Further, also the number of the units 36 is not limited to the above described but can arbitrarily be

selected and also the clamp piece is not limited to the grab clamp 27.

Further, Fig.16 and Fig.17 show a sinking apparatus 38 according to a sixth embodiment. The sinking apparatus 38 is constituted by integrating two pontoons 2 in double barrels to be able to form the opening portion 3, and other constituent elements are same as that of the sinking apparatus 1 according to the first embodiment.

The sinking apparatus 38 is made by connecting two pontoons 2 with the two front and rear support legs 8 into double barrel, forming the opening portion 3 between the two pontoons 2, and containing the sinking bucket 4 in the opening portion 3. Further, the guide legs 7 of the sinking bucket 4 are supported with capable of ascending and descending by the two front and rear support legs 8.

In this way, by connecting two pontoons 2, the large opening portion 3 can simply be formed therebetween without forming the opening portion 3 at the center portion of one large pontoon 2. Further, the sinking apparatus 38 is applicable also to the sinking apparatus 21A, 21B, 25 and 35 according to the second, the third, the fourth and the fifth embodiments.

Next, an explanation will be given of a sinking method using the respective sinking apparatuses described above. First, an explanation will be given of a sinking method according to the first embodiment using the sinking apparatus 1 according to the first embodiment in reference to Fig.1 through Fig.7. According thereto, for example, as shown in Fig.15, the bag 40 filled with soil, that is, the bagged soil is sunk to a sea-bottom 41, and a submarine embankment 42 is constructed by piling up those into a pyramid shape.

First, as shown in Fig.1 through Fig.3B, the sinking bucket 4 is contained in the opening portion 3 of the pontoon 2 of the sinking apparatus 1, and the water permeable bag 40 made of geo-textile is installed at the sinking bucket 4. The bag 40 is formed in a cylindrical shape capable of being contained in the sinking bucket 4 and has 3 pieces of soil filling ports 43 at equal intervals at an upper face thereof. Nothing is put thereinto at the time point, and therefore, the bag 40 is installed in a state of being extended, that is, in a widely opened state at inside of the sinking bucket 4.

Next, 3 pieces of the soil filling ports 43 of the bag 40 are connected to pressurizing pipes 44 of soil. Further, in parallel with the operations, the pontoon 2 is towed by a tow boat to a portion to sink the bag 40, and the positioning to sink the bag 40 is made by reeling out or winding back the ship operating wires 20 from the ship operating winches 18. The pontoon 2 can be positioned by the ship operating wires 20 in this way, and the bag 40 can be sunk to an accurate position by reducing rolling and pitching of the ship body.

Next, soil 45 is pressurized from the soil filling ports 43 into the bag 40 by a pressurizing

pump (not illustrated), in order to maintain a balance of the bag 40, the soil 45 is pressurized uniformly from three pieces of the pressurizing pipes 44. The soil 45 is pressurized under the water surface by moving down the sinking bucket 4 to operate buoyancy to the bag 40. When predetermined amounts of the lifting wires 11 are reeled out from the lifting winches 10, the sinking bucket 4 descends with being guided by the guide legs 7 by its own weight.

Next, after confirming that a scheduled amount of the soil 45 is filled in the bag 40, the pressurizing pump is stopped, all of the pressurizing pipes 44 are drawn from 3 pieces of the soil filling ports 43, and the soil filling ports 43 are closed. At this occasion, although the bag 40 filled with the soil 45 is formed in a shape of a cylinder having a length of about 30 m and a considerable weight, the buoyancy is utilized under the water surface, and therefore, the sinking bucket 4 is not exerted with a large force to be able to be held by the opening/closing wires 14.

Next, as shown in Fig.4 and Fig.5, the sinking bucket 4 is sunk with being guided by the guide legs 7. As described above, the operation is carried out by reeling out the lifting wires 11 from the lifting winches 10 and reeling out the opening/closing wires 14 from the opening/closing winches 13 by driving the lifting winches 10 and the opening/closing winches 13 by a remote operation from the operating/controlling chamber 19. Further, when the sinking bucket 4 is disposed at a predetermined depth, that is, a portion at which the bottom plates 6 can be rotated (portion at which a distance H capable of rotating the bottom plates 6 can be ensured), the sinking bucket 4 is stopped from being sunk by stopping to drive the lifting winches 10 and the opening/closing winches 13.

Next, after confirming again a position to sink the bag, as shown in Fig.6, when the opening/closing wires 14 are reeled out by a predetermined amount by driving the opening/closing winches 13 by a remote operation from the operating/controlling chamber 19, the bottom plates 6 are opened from the center portion by the weight of the bag 40 and the bag 40 is dropped to the sea-bottom 41. Owing to the small distance, that is, the distance H capable of rotating the bottom plates 6, a danger of damaging to break the bag 40 is reduced.

Further, when the sinking bucket 4 is not stopped at a location capable of rotating the bottom plates 6 but after stopping the sinking bucket 4 at a location of a small distance (several tens centimeters) from the sea-bottom 41 (at the time point, both of the lifting winches 10 and the opening/closing winches 13 are brought into a stopped state), only the lifting wires 11 are wound back to the lifting winches 10 and the sinking bucket 4 is moved up, a predetermined amount of the opening/closing wires 14 are brought into a reeled out state, and therefore, the bottom plates 6 are opened by the weight of the bag 40 and the bag 40 is dropped to the sea-bottom 41.

On the other hand, Fig.7 shows other sinking method, after getting down the sinking

bucket 4 temporarily to the sea-bottom 41, the bottom plates 6 are opened. First, when the sinking bucket 4 is sunk to get down to the sea-bottom 41 by a method as same as the above-described, the lifting wires 11 and the opening/closing wires 14 are stopped from being reeled out. At the time point, both of the lifting winches 10 and the opening/closing winches 13
 5 are brought into a stopped state. Next, when the sinking bucket 4 is moved up by winding back only the lifting wires 11 to the lifting winches 10, there is brought about a state of reeling out a predetermined amount of the opening/closing wires 14, and therefore, the bottom plates 6 are opened by the weight of the bag 40 and the bag 40 is cast to the sea-bottom 41.

According thereto, after temporarily getting down the bag 40 to the sea-bottom 41, the
 10 bag 40 is slightly moved up and then moved down, and therefore, damage of the bag 40 can further be reduced (the bag is hardly damaged). According thereto, the bag 40 may be to say installation rather than casting of the bag 40 since the bag 40 is only slightly moved. After finishing the installation of the bag 40, the bottom plates 6 are closed while moving up the vacant sinking bucket 4 to proceed to an operation of a next casting step.

15 Further, the bag 40 can also be cast or dropped by opening the bottom plates 6 by a method as same as the above-described not by getting down the sinking bucket 4 to the sea-bottom 41 as described above, but after stopping the sinking bucket 4 at a location of a slight distance (several tens centimeters) from the sea-bottom 41. By successively repeating the operation, the submarine embankment 42 as shown in Fig.15 is constructed.

20 Next, an explanation will be given of a sinking method according to a second embodiment by using the sinking apparatus 21A according to the second embodiment in reference to Figs.8A and 8B.

First, the sinking bucket 4 of the sinking apparatus 21A as shown in Figs.8A and 8B is sunk only by reeling out the lifting wires 11 (the sinking bucket 4 is not connected with the
 25 opening/closing wires 14 from the opening/closing winches 13). Further, as shown in Fig.8A, the sinking bucket 4 is stopped from being sunk when the sinking bucket 4 is disposed at a predetermined depth, i.e. at a portion at which the bottom plate 6 can be rotated (a portion at which the distance H capable of rotating the bottom plates 6 can be ensured).

Next, as shown in Fig.8B, when the cylinder rods 23 of the hydraulic cylinders are
 30 retracted by a remote operation of the operating/controlling chamber 19, the bottom plates 6 are opened from a center portion and the bag 40 is dropped to the sea-bottom 41. Owing to the slight distance, that is, the distance H at which the bottom plates 6 can be rotated, the danger of damaging to break the bag 40 is extremely reduced. After finishing the installation of the bag, the bottom plates 6 are closed while moving up the vacant sinking bucket 4 to proceed to an

operation of a next casting step. By successively repeating the operation, the submarine embankment 42 as shown in Fig.15 is constructed.

Further, also a method for opening the bottom plates 6 after getting down the sinking bucket 4 temporarily to the sea-bottom 41, and a method for opening the bottom plates 6 after
 5 stopping the sinking bucket 4 at a location of a small distance (several tens centimeters) from the sea-bottom 41 without getting down the sinking bucket 4 to the sea-bottom 41 can be carried out in the above-described sinking apparatus 21A. Further, the above-described sinking method is applicable also to the sinking apparatus 21B in Figs.9A and 9B.

Next, an explanation will be given of a sinking method according to the fourth
 10 embodiment by using the sinking apparatus 25 according to the fourth embodiment in reference to Fig.10 through Fig.13B.

First, as shown in Figs.11A through 11D, the hanging frame member 26 is contained at the opening portion 3 of the sinking apparatus 25, a temporary scaffolding (not illustrated) for extending the bag 28 is installed at the hanging frame member 26, and the bag 28 is installed on
 15 the temporary scaffolding. Although the bag 28 is same as the above described, the bag 28 is formed with the grab strips 32 opened with the inserting holes 33 at equal intervals at both sides in the length direction. Nothing is put into the bag 28 at the time point, and therefore, the bag 28 is installed in an extended state, that is, in a widely opened state on the temporary scaffolding.

Further, as shown in Fig.11A, the grab strips 32 of the bag 28 are grabbed by the grab
 20 clamps 27 of the hanging frame member. According thereto, as shown in Figs.11B and 11C, the pins 31 of the grab clamps 27 are inserted into the inserting holes 33 of the grab strip 32. When the grab strips 32 are grabbed by the grab clamps 27, the bag 28 is brought into a state of being hung down from the hanging frame member 26.

Next, as shown in (A) of Fig.12, the pressurizing pipes 44 of the soil are connected to 3
 25 pieces of the soil filling ports 43 of the bag 28, the hanging frame member 26 is moved down by a method as same as the above-described to thereby make the bag 28 disposed under the water surface. Further, in parallel with the operations, the pontoon 2 is towed to a sinking portion by a towboat and is positioned by a method as same as the above described.

Next, as shown in (B) and (C) of Fig.12, the soil 45 is pressurized into the bag 28 from
 30 the soil filling ports 43 by the pressurizing pumps and the soil is uniformly pressurized from 3 pieces of the pressurizing pipes 44 while maintaining a balance of the bag 28. Further, after confirming that a scheduled amount of the soil 45 is filled into the bag 28, the pressurizing pumps are stopped, and all of the pressurizing pipes 44 are drawn from 3 pieces of the soil filling ports 43 and the soil filling ports 43 are closed. At this occasion, the bag 28 filled with the soil 45 is formed

in a semi-cylinder shape having a length of about 30 m and a considerable weight. However, the buoyancy is utilized under the water surface, and therefore, the hanging frame member 26 is not exerted with a large force and can be maintained by the grab clamps 27.

5 Next, as shown in (A) of Fig.13, the hanging frame member 26 is sunk with being guided by the guide legs 7. The operation is carried out by reeling out the lifting wires 11 from the lifting winches 10 by driving the lifting winches 10 by a remote operation from the operating/controlling chamber 19 as described above. Further, after getting down the bag 28 to the sea-bottom 41, the lifting winches 10 are stopped from being driven and the hanging frame member 26 is stopped from being sunk.

10 Next, after confirming again the position to sink the bag, as shown in (B) of Fig.13, the pins 31 of the grab clamps 27 are drawn from the inserting holes 33 by a remote operation from the operating/controlling chamber 19, the grab clamps 27 are removed from the grab strips 32, and the bag 28 is installed at the sea-bottom 41. According thereto, the bag 28 is not cast to the sea-bottom 41 but the bag 28 is installed to the sea-bottom 41 by controlling the bag 28 until
15 getting down to the bottom, and therefore, the bag 28 is not damaged. After finishing the installation, the hanging frame member 26 removed the bag 28 is moved up to proceed to operation of a next casting step. By successively repeating the operation, as shown in Fig.15, the submarine embankment 42 is constructed.

20 Next, an explanation will be given of a sinking method according to a fifth embodiment by using the sinking apparatus 35 according to the fifth embodiment in reference to Fig.14. The sinking method differs only in that the grab clamps 27 constitute the units 36, and the other constituent elements are as same as the sinking method according to the fourth embodiment.

Further, a series of operations by the sinking methods according to the first through the fifth embodiments are carried out by the remote operation from the operating/controlling chamber
25 19 except portions of manual operations by an operator.

Further, the sinking methods according to the first through the fifth embodiments are applicable also to the sinking apparatus 38 according to the sixth embodiment shown in Fig.15 and Fig.16.

WHAT IS CLAIMED IS:

1. A method for sinking a bag of soil, comprising the steps of providing a sinking bucket guided with guide legs which are able to move up and down at an opening formed in a pontoon and penetrate a water surface, sinking into the water a bag carried on the sinking bucket and filling the bag with soil below the water surface, sinking the sinking bucket being guided by the guide legs and thereafter, opening a bottom plate of the sinking bucket and dropping the bag.

2. A method for sinking a bag of soil, comprising the steps of providing a hanging frame member guided with guide legs which are able to move up and down at an opening formed in a pontoon and penetrate a water surface, hanging a bag by grab pieces provided with the hanging frame member, sinking into the water the bag and filling the bag with soil below the water surface, sinking the hanging frame member being guided by the guide legs until the bag has reached the bottom of the water and thereafter, releasing the bag from the grab pieces.

3. The method for sinking a bagged soil according to Claim 1 or 2, wherein the bag has a plurality of soil filling ports and the soil is uniformly filled into the bag from the filling ports.

4. The method for sinking a bagged soil according to Claim 1, wherein the sinking bucket is moved up or down by reeling out or winding back a lifting wire from a lifting winch connected to the sinking bucket and an opening/closing wire from an opening/closing winch connected to the bottom plate of the sinking bucket and the bottom plate is opened/closed by reeling out or winding back the opening/closing wire from the opening/closing winch.

5. The method for sinking a bagged soil according to Claim 4, wherein the bottom plate is opened by reeling out the opening/closing wire from the opening/closing winch after sinking the sinking bucket into water to stop at a predetermined depth by reeling out the lifting wire and the opening/closing wire, or the bottom plate is opened by pulling up the sinking bucket by winding back only the lifting wire.

6. The method for sinking a bagged soil according to Claim 4, wherein the bottom plate is opened by sinking the sinking bucket into water by reeling out the lifting wire and the opening/closing wire until getting down to a water-bottom, thereafter, pulling up the sinking bucket by winding back only the lifting wire.

7. An apparatus for sinking a bagged soil, comprising a pontoon having an opening penetrated to a water surface, a sinking bucket contained in the opening and having at least a bottom plate being able to open and close, guide legs that guides for the sinking bucket to move up and down,

wherein the sinking bucket is connected with a lifting wire from a lifting winch provided on

the pontoon, and also the bottom plate of the sinking bucket is connected with an opening/closing wire from an opening/closing winch.

8. An apparatus for sinking a bagged soil, comprising a pontoon having an opening penetrated to a water surface, a sinking bucket contained in the opening and having at least a bottom plate being able to open and close, guide legs that guides for the sinking bucket to move up and down,

wherein the sinking bucket is connected with a lifting wire from a lifting winch provided on the pontoon, and also the bottom plate of the sinking bucket is connected with an opening/closing wire from an opening/closing winch by way of a front end of a cylinder rod of a hydraulic cylinder installed at the sinking bucket, and the bottom plate is opened/closed by extracting and retracting the cylinder rod.

9. An apparatus for sinking a bagged soil, comprising a pontoon having an opening penetrated to a water surface, a hanging frame member contained in the opening, guide legs that guides for the hanging frame member to move up and down,

wherein the hanging frame member is connected with a lifting wire from a lifting winch provided on the pontoon, and a plurality of grab pieces is installed at the hanging frame member.

10. The apparatus for sinking a bagged soil according to Claim 9, wherein a plurality of the grab pieces are summarized into one to constitute a unit.

11. The apparatus for sinking a bagged soil according to any one of Claims 7 to 10, wherein the pontoon is constituted by integrating two pontoons in double barrels to be able to form the opening.