METHOD AND APPARATUS FOR PRESS-INSERTION

Inventor: Masaaki Uchida, No. 13-12, 4-chome, Morishita, Koto-ku, Tokyo, Japan

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Attorney, Agent, or Firm—Eliot S. Gerber

ABSTRACT
There is provided a method for press-insertion having the steps of holding vertically a press-insertion member, positioning a weight above the press-insertion member, lowering the weight to push down the press-insertion member, then lifting up to weight, positioning another press-insertion member between the weight and the press-insertion member, and lowering again the weight to push down the press-insertion members. There is also provided an apparatus to operate and establish the aforementioned method.

7 Claims, 7 Drawing Figures
METHOD AND APPARATUS FOR PRESS-INSERTION

BACKGROUND OF THE INVENTION

This invention relates to an apparatus and method for press-inserting a press-insertion member such as steel pipe into the ground or into the sea-bed.

So far, where a press-insertion member is to be press-inserted into the ground, there has been used a method known as Franky insertion method which press-inserts a pile made of steel pipe into the ground by means of a jack in order, for example, to construct the foundation for building. However, according to such a conventional method and apparatus, since a pile is inserted by means of a jack, counterforce of the pressing force exerted on the jack will have to be received, and for this purpose it had been a practice to drive a number of piles in addition to one which is just being inserted into the ground to use them as anchors for receiving the above-mentioned counterforce. Hence such a method has usually been resulted in economically expensive operation, making itself not applicable when or where driving of piles is not allowed. Such apparatus and method had also been allowed only on a small scale.

Also where press-insertion is being required on the ocean, for example, where natural resources such as oil and natural gas, are extracted on the ocean by boring vessel, etc., there have been involved tremendous expenses allowing the operation only where the extraction conditions are satisfied.

In conventional construction of high-storied buildings such as skyscrapers, a great many foundations such as pedestals have to be firstly constructed. If fewer pedestals of 10 m in diameter for foundations can be utilized and applied in place of the conventional great many foundations, such foundations, the inventor has come to the conclusion, can be decreased in number and the foundation construction can be made simpler. Moreover, the inventor has been studying and come to the conclusion that foundation can effectively and favorably constructed under the sea-bed if the press-insertion members are pressed and inserted continuously by the weight of sea-water. When such a huge press-insertion member is pressed and inserted by the conventional method or device, it will induce unbearable noise and shock or vibration. It is evident that the conventional method such as Franky method as described before can not accomplish the construction of such huge foundations as the press-insertion member of 10 m in diameter. Furthermore, where development is made on the continental shelf of a water depth of 100 to 200 meters or more, conventional extraction technique could hardly be utilized.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide method and an apparatus of press-insertion which does not require any facilities for receiving counterforce exerted on the pressure device when a press-insertion member is being press-inserted.

Another object of this invention is to provide method and an apparatus for inserting the press-insertion members with continuous piling of the press-insertion members by means of the weight of sea-water.

Another object of this invention is to provide a method and an apparatus which allows for the press-insertion member to be inserted by the own weight of the weight without requiring a special pressure means.

According to this invention there is provided a method for press-insertion by holding the press-insertion member vertically on a place where said member will be driven into, positioning the weight above said press-insertion member, and gradually lowering said weight so that the press-insertion member is inserted continuously by repeating the aforementioned steps.

Furthermore, according to this invention there is provided an apparatus for press-insertion comprising a press-insertion member, a means of holding said press-insertion member vertically with respect to the press-insertion surface, a weight, and a means for raising and gradually lowering down said weight, in order that said press-insertion member is press-inserted due to the own weight of said weight.

Other objects and features of this invention will become more clearly apparent from the detailed description thereof, which is to be read with reference to the accompanying drawings.

BRIEF EXPLANATION OF DRAWINGS

FIG. 1(a) and (b) show a first embodiment of the apparatus for press-insertion of this invention.

FIG. 2 shows a second embodiment of the apparatus for press-insertion of this invention.

FIG. 3 is a third embodiment of the apparatus for press-insertion of this invention.

FIG. 4 is a fourth embodiment of the apparatus for press-insertion of this invention.

FIG. 5 is a fifth embodiment of the apparatus for press-insertion of this invention.

FIG. 6 is another embodiment of the press-insertion member used for the press-insertion apparatus of this invention.

FIG. 7 is another embodiment of the apparatus for press-insertion of this invention.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIG. 1(a), a pile formed by a steel tube serves as a press-insertion member 1 which is held by a holding means 5 at a place where press-insertion will be carried out and vertically to the ground surface 2. And FIG. 1(a) shows a state before the press-insertion is carried out; the weight 3 formed by concrete blocks is lifted up by means of the two hydraulic pressure means 4 above the head of the press-insertion member 1. The gravity of the weight is maintained at an extended vertical line from the press-insertion member 1.

When the press-insertion member is just being press-inserted as shown in FIG. 1(b), hydraulic pressure of the hydraulic pressure means 4 is gradually released so that the lower surface of the weight 3 comes into contact with the head of the press-insertion member 1. And the hydraulic pressure of the hydraulic pressure means is further released causing the press-insertion member 1 which is tapered at the end portion thereof to be press-inserted into the ground by the self weight of the weight 3. The gravity of the weight is collected at the tapered end portion.

The weight 3 may be of any material, such as a vessel containing water or earth and sand, or a lamination of iron and lead. As a means for lifting up and slowly lowering down the weight 3, the hydraulic pressure or a means such as jack utilizing screw torque may be em-
ployed. Although FIG. 1 shows a holding means for holding the press-insertion body 1 vertically to the ground surface, as a single independent unit, the holding means may be incorporated in the pressure means 4.

As mentioned above, the weight 3 lifted up by the pressure means 4 is slowly lowered down so that its own weight causes the press-insertion member 1 to be inserted into the ground. And after such press-insertion operation has finished, the second or third press-insertion members may be prepared as required to join to the first press-insertion member and may be press-inserted. Repeating such operation, it is possible to insert the press-insertion members into a required depth.

Preferably, after the press-insertion member is driven into the ground, the ground contacted with a lower end portion of said press-insertion member is partly dug so that the following press-insertion may be effectively operated.

As mentioned in the foregoing, the apparatus for press-insertion of this invention performs press-insertion by means of the self weight of the weight prepared beforehand, without requiring any additional means for receiving the counterforce which with a conventional method will be exerted on the pressure means, and hence the press-insertion operation in this invention can be performed with little noise and vibration.

Referring to the second embodiment of this invention shown in FIG. 2, the pressure means 4 comprises a larger water vessel 6 containing water, and a smaller water vessel placed on said large vessel upside down or in other words in such a manner that its bottom is at the top thereby forming an air chamber 8, so that by blowing air into the air chamber to expand its volume the weight 3 can be held at a position above the press-insertion member 1. Then air in the air chamber 8 formed in the smaller water vessel is exhausted gradually and the position of the smaller water vessel is lowered, causing the weight 3 to be lowered down. The press-insertion member 1 is pressed by the self weight of the weight 3 and is driven into the ground. In this case, it is of course possible as mentioned above to prepare or make ready the second and third press-insertion members to drive them into the ground to a desired depth.

In this embodiment, if the weight is formed with a container which contains water therein, water in the larger vessel may be flowed to the container to make the water level of the larger vessel lower down, whereby lowering the weight, i.e., the water container, downward to press and insert the press-insertion member.

In the first and the second embodiments of this invention above, the press-insertion members of a cylindrical form are employed. In such cases, however, the cylindrical press-insertion members after charging concrete, etc., may be removed, if necessary, by means of the pressure means 4 to re-use them.

Referring to the third embodiment of this invention shown in FIG. 3, the apparatus comprises plural tanks 11 containing sea-water, a suspension bed 12 to suspend the tanks 11 from the above, and an opening (not shown) at the central portion 14 of the bridge 13 of the suspension bed 12, wherein a support member 15 movable up and down and can be stopped is being inserted in said opening, thereby constituting the pressure means and the weight as referred to in the foregoing first and second embodiments by means of said tanks, bed and support member. The tank 11 contains an air chamber 16 and is so formed as to float. According to this third embodiment, the press-insertion member 1 is held vertically to the sea-bed, seawater is introduced to the floating tanks to reduce the volume of the air chamber and to increase the weight of the tanks in order to press-insert the press-insertion member 1 into the sea-bed. To insert the press-insertion member, first, the upper end of the press-insertion member held perpendicularly and vertically to the sea-bed is positioned to face to the lower end of the support member 15 which is inserted movably and stoppably through the center 14 of the suspension bed 12 suspending tanks 11. Then the sea-water is introduced to the tanks to increase the weight of the tanks and to lower down the tanks. The suspension bed linking the tanks is also lowered down to force the press-insertion member into the sea-bed.

After the tanks and the suspension bed have been lowered down to a determined level, the sea water in the tanks is removed, and the tanks are floated up to their initial level. At this moment, between the upper end of the press-insertion member 1 and the lower end of the support member 15, there will develop a clearance equal to the distance of the press-insertion effected by the previous operation. Then the support member is disengaged to lower down the lower end of said support member 15 until the upper end of the press-insertion member 1 is touched, and the support member 15 is stopped.

Then the above-mentioned operation is repeated to drive the press-insertion members 1 into the sea-bed. After the support member 15 has been lowered down to its lowest level, the support member 15 is then lifted up to its highest level. And into the clearance between the upper end of the press-insertion member 1 and the lower end of the support member 15 is inserted a charge which will be press-inserted or new press-insertion member is fastened by means of welding or bolt to continue the press-insertion. This may be repeated required number of times depending on a purpose.

The structure of the support member may be of a thick threaded bar being screwed vertically through a screw hole at a bridge of the suspension bed, or may be of a column having in its lengthwise direction cuts or projections for a stopping purpose and being installed through the bridge of the suspension bed in such a manner as to move up and down and to stop.

Referring to the fourth embodiment of this invention shown in FIG. 4, the tank comprises a first tank 21 for increasing the weight and the second tank 22 which serves as a float, the first tank and the second tank being linked together with several columns as shown in FIG. 4. Illustrating the press-insertion operation, the press-insertion member 1 is erected vertically on the sea-bed, and the upper end of the press-insertion member 1 is pushed down by the lower end of the support member 15. At this moment, the second tank 22 which works as a float has been filled with air thereby forming an air chamber 16. As the valve (not shown) of the air chamber 16 is opened, air in the air chamber goes out and the sea water enters into there reducing the floating force of the second tank 22 which works as a float, so that the two first tanks 21 linked to the second tanks 22 and the suspension bed 12 spanning over the two
first tanks will be lowered down. In this way, the press-insertion member 1 will be driven into the sea-bed. Then air is blown into the second tanks 22 from the air compressor 23 provided on the suspension bed through the pipes 24, in order to exhaust the sea-water out of the second tanks; the floating force of the second tanks increases again causing the first tanks 21 and the suspension bed 12 to rise to their initial position. At this moment, there will develop a clearance between the upper end of the press-insertion member 1 and the lower end of the support member 15. The clearance obtained through this embodiment will be considerably greater than the clearance obtained through the third embodiment of FIG. 3. Hence without repeating the press-insertion operation, i.e., through only one press-insertion operation, the charge can be inserted or a new press-insertion member can be inserted, thus being more efficient as compared to the embodiment of FIG. 3.

The fifth embodiment of this invention shown in FIG. 5 provides a pressure means such as of a hydraulic type on the suspension bed 12 for the purpose of substantially increasing the weight of the sea-water tank which serves as a weight.

FIG. 5 shows an instance where a pressure device 25 such as of a hydraulic type supported by suspension bed 12 pushes the press-insertion member 1 in order to substantially increase the driving force of the press-insertion member 1 into the sea-bed 2.

The apparatus shown in FIG. 5 having tanks 21, and a pressure device 25 such as of a hydraulic type being supported by said tanks 21. As the pressure device 25 pushes down the press-insertion member 1 erected on the sea-bed, the tanks 21 and the suspension bed 12 is lifted up due to the counterforce, so that the weight exerted on the press-insertion member 1 is increased, and the press-insertion member 1 is driven into the sea-bed as in the case of the above embodiment. In this case, to increase the force of press-insertion, the sea-water should be introduced into the sea-water tanks 21 thereby increasing their weight.

The press-insertion member 1 should not be limited those of tubular form but may of any shape. For example, a tower as shown in FIG. 6 may be driven into the sea-bed together with the foundation 27. Or as shown in FIG. 7, a relatively short press-insertion member 1 may be put atop the long column 1', and the column 1' may be pushed down by the above-mentioned method to press-insert the portion of the press-insertion member 1 which will be press-inserted and then pulling up only the column 1'. In this way, many piles and foundation, as well as dwelling space 30 and pressure-resistant and water-resistant building structure having snorkel 31, can be press-inserted at one time.

Though the present invention has been described with reference to the preferred embodiments thereof, many modifications and alterations may be made. For example, the tanks 11 may be vessels or ships.

What I claim is:

1. A method for press-inserting having the steps of holding a press-insertion member vertically on a place where the press-insertion be effected, positioning a weight above said press-insertion member, lowering said weight to press and insert said press-insertion member, lifting said weight upward, arranging and holding another press-insertion member between said weight and said press-insertion member, lowering again said weight to push both of said press-insertion members.

2. A method for press-inserting having the steps of erecting and holding vertically a press-insertion member of a steel pipe or a steel stake, positioning a weight above said press-insertion member so that a center gravity of said weight lies on a line extended longitudinally from said press-insertion member, lowering said weight to push said press-insertion member, lifting said weight upward, arranging and holding another press-insertion member vertically between said weight and said press-insertion member, and then lowering again said weight to push further said press-insertion member.

3. A method for press-inserting as claimed in claim 2, wherein after lowering said weight to push said press-insertion member, digging the ground which contacts a lower end portion of said press-insertion member to allow a following press-insertion be operated effectively.

4. An apparatus for press-inserting comprising a press-insertion member having a tapered end portion, means for holding said press-insertion member in a vertical position, weight means, and means for repeatedly raising and repeatedly gradually lowering said weight means, said raising and lowering means comprising a vessel disposed in the water and forming a closed air chamber therein so that changing of the volume of air in said air chamber causes said weight means to be lifted up or lowered down, thereby allowing the repetitive press-insertion of said press-insertion member.

5. An apparatus as claimed in claim 4, wherein said vessel is disposed within an additional larger vessel containing water therein.

6. An apparatus as claimed in claim 4, wherein said weight means comprises a suspending device connected to said press-insertion member, a water tank having water therein which is suspended from said suspending device and is connected to said vessel, and an air compressor having an air tube one end of which is disposed within said vessel.

7. An apparatus for press-inserting comprising a press-insertion member such as a steel pipe or a steel stake with tapered end portions thereof, a means for holding said press-insertion in a vertical manner with respect to a surface of press-insertion, a weight, and a lifting means for repeatedly raising and repeatedly gradually lowering said weight, said lifting means raising said weight so that the press-insertion is operated repeatedly, wherein said weight lifting means comprises a large water vessel containing water, a small water vessel whose bottom is at the top of said large water vessel thereby forming an air chamber between the lower surface of said small vessel and the water level of said large water vessel, so that the change of volume of air within said air chamber causes the weight to be lifted up or lowered down.

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