

BACKGROUND OF THE INVENTION**KITY-II**

The present invention relates to a piling rig, and, more particularly, to a piling rig which is capable of driving a pile in marine construction.

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DESCRIPTION OF THE PRIOR ART

Conventionally, pile driving in marine construction is carried out using a piling rig mounted on a piling barge and having a leader boom which is fixed thereon in a substantially vertical position. The leader boom has a hydraulic hammer for exerting an impact on a top end of a pile charged to the leader boom, whereby the pile is driven into the seabed. Usually, a stack of piles is transported by a second barge. Wire slings are fastened to one of the piles and a spreader bar is attached to the wire slings. The pile is lifted by picking up the spreader bar by a crane mounted on the second barge. While the hydraulic hammer is positioned at a top of the leader boom, the pile is charged to the leader boom in a vertical position by manoeuvring the crane. After the pile has been charged to the leader boom, it is held by a clamp mounted thereon and the pile is ready to be driven into the seabed by the hydraulic hammer.

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In marine construction, pre-stressed concrete piles, each having a substantially long span, are often used. When such pre-stressed concrete piles are to be used for construction, they must be handled with due caution because exerting a bending moment on such a pile is critical. As mentioned above, in order to charge the pile to the leader boom in a substantially vertical position, one end of the pile brought to the piling barge must be raised by the crane while the other end is resting on the barge, whereby a bending moment is exerted on the pile that may cause cracking or breakage of the pile. Therefore, in order to avoid such cracking or breakage of the pile, the charging operation requires a highly skilled operator and it is a time consuming operation.

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Our Singapore application 9702392-3 describes a piling rig carried on a barge. The design allows for a pile to be loaded into a horizontal bed which is then tilted up into position at various raking angles in two dimensions.

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SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an improved piling rig that prevents damage to a pile during the charging operation and which enables a
5 reduction in overall time required to charge each pile to the leader booms.

The present invention provides a piling rig carried on a barge having a horizontal bed which can be positioned at various rake angles in three dimensions. A rig constructed in this way means that the barge would not need to be repositioned for driving piles of
10 different rake angles, thereby saving construction time.

The above and other objects of the present invention can be accomplished by a piling rig carried on a barge comprising a first leader boom adapted for pivotal movement with respect to said barge; means for rotating the first leader boom between a
15 substantially horizontal position and an upright position; and a second leader boom supported by said first leader boom and adapted for pivotal movement with respect to said first leader boom; said second leader boom being provided with clamping means for securing a pile charged thereto during movement of said leader booms and hammer means for driving the pile.

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The above and other objects and features of the present invention will become apparent from the following description made with reference to the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

A preferred form of the piling rig will now be described by way of example and without intending to be limiting with reference to the accompanying drawings in which:

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Figure 1 is a schematic side view of a piling rig mounted on a piling barge according to the present invention;

Figure 2 is a side view of the piling rig where a pile is charged to a leader boom;

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Figure 3 is a perspective view of the piling rig showing operation of a lifting frame;

Figure 4 is a perspective view of the piling rig showing operation of power cylinders;

Figure 5 is a perspective view of the piling rig showing pivotal movement of the second
5 leader boom with respect to the first leader boom; and

Figure 6 is a perspective view of the piling rig showing operation of the second leader boom.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 is a schematic side view of a piling rig mounted on a piling barge according to the present invention.

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Referring now to Figure 1, a piling rig constructed in accordance with the present invention is identified by a reference numeral 2 and installed on a piling barge 4 whose stem and stern are shown on the left and right hand sides as viewed in Figure 1, respectively.

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The piling rig 2 is provided with a first leader boom 8 pivotally connected at a pivot point 10 to the barge 4 at its fore end. The first leader boom 8 is initially laid on the barge 4 in a substantially horizontal position. A second leader boom 12 is pivotally connected to the first leader boom 8 at a pivot point 14.

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A lifting frame 16 is provided for rotating leader booms 8 and 12 about the pivot point 10 from the substantially horizontal position to an inclined intermediate angular position in a counter clockwise direction as viewed in Figure 3. In a preferred form of the invention the lifting frame 16 is provided with winches (not shown) to perform
30 rotation of the leader booms 8 and 12.

In a preferred arrangement, two power cylinders 18, in the form of hydraulic rams are provided. The power cylinders 18 are positioned between the first leader boom 8 and the barge 4 to rotate the leader booms 8, 12 about the pivot point 10 from the inclined
35 intermediate angular position to an upright position in a counter clockwise direction as viewed in Figure 4.

The power cylinders 18 are slidably mounted on the barge 4 so that the bases of the power cylinders 18 slide forward during lifting of the booms 8, 12 by lifting frame 16. Once the booms 8, 12 are lifted to the inclined intermediate angular position, the bases of the power cylinders 18 are locked in position in preparation for lifting the
 5 booms 8, 12 to an upright position. Preferably a steel pin is used to lock the cylinders 18.

Once the booms 8, 12 have been lifted to the upright position, the second leader boom 12 may be pivoted about pivot point 14 with respect to the first leader boom 8, as
 10 shown in Figure 5. The second leader boom 12 may be rotated either clockwise or counter clockwise. Known means, for example winches, may be used to move the leader boom 12 to the desired position and secure the leader boom 12 in this desired position.

15 A hydraulic hammer 20 is provided for exerting an impact on a pile to be driven and is slidably mounted on the second leader boom 12. Hammer winches (not shown) are provided to move the hydraulic hammer 20 upwardly along the second leader boom 12. The hydraulic hammer 20 has a hammer cap 22 adapted to hold the end of the pile charged to the second leader boom 12. Prior to the charging of the pile to the second
 20 leader boom 12, the hydraulic hammer 20 is positioned at an aft end of the second leader boom 12 as shown in Figure 1. The second leader boom 12 is further provided with a clamp 26 to secure the pile charged thereto during movement of the leader booms.

25 Figure 2 is a side view of the piling rig where a pile 30 is charged to the second leader boom 12.

The charging operation of a pile to the second leader boom 12 may be carried out as follows. A stack of piles are usually transported on a second barge (not shown) and
 30 wire slings (not shown) are fastened to one of the piles carried thereon. A spreader bar (not shown) is attached to the wire slings and the pile is lifted in a horizontal position by picking up the spreader bar by a crane (not shown) mounted on the second leader boom 12. Then, it is moved toward the piling rig 2 on the piling barge 4 by manoeuvring the crane (not shown).



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The pile 30 is placed horizontally on the second leader boom 12 and a first end of the pile 30 is inserted into the cap portion 22 of the hydraulic hammer 20 as shown in Figure 2. Then, the second end of the pile 30 is tightly secured to the second leader boom 12 by the clamp 26.

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After the pile 30 has been charged to the second leader boom 12 as shown in Figure 2, the booms 8, 12 are rotated about the pivot point 10. The booms 8, 12 are first rotated to the inclined intermediate angular position about the pivot point 10 by lifting frame 16. When the booms 8, 12 are rotated to the intermediate position, the power cylinders 18 are actuated, whereby the booms 8, 12 are rotated from the inclined intermediate angular position toward the upright position. The actuation of the power cylinders 18 are stopped when the leader booms 8, 12 have reached the upright position at a predetermined angle parallel to the barge at which the pile 30 should be driven into the seabed. The angle is normally selected to be between +20 degrees and -20 degrees with respect to a vertical axis parallel to the barge.

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Once the desired angle with respect to a vertical axis parallel to the barge has been selected, the second leader boom 12 is rotated about pivot point 14 with respect to the first leader boom 8. In this way, the desired angle perpendicular to the barge for the pile 30 may be selected. The angle is normally selected to be between +20 degrees and -20 degrees with respect to a vertical axis perpendicular to the barge.

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When the piling rig 2 is fully deployed to the upright position at the predetermined angular position, it is fixed thereat. Then, the position of the barge 4 may be adjusted with anchor winches (not shown) so that the pile 30 is located at the position where it should be driven into. Then, the clamp 26 is loosened to allow the pile 30 to slide down along the second leader boom 12 due to its own weight as shown in Figure 6. As mentioned above, it should be noted that the hammer winches (not shown) are released to permit the free movement of the hydraulic hammer 20 with the pile 30. Then, an impact is exerted on the pile 30 at its top end by actuation of the hydraulic hammer 20 which causes to drive the pile 30 into the seabed at the predetermined angle. Such driving operation is continued until the pile 30 is driven into the seabed to the predetermined depth.

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When driving of the pile 30 is completed, the hammer winches (not shown) are actuated. The hydraulic hammer 20 is raised thereby to the top end of the second

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leader boom 12, whereby the pile 30 is released from the cap portion 22 of the hydraulic hammer 20. Then, the leader booms 8, 12 are rotated back to the horizontal position by reverse operation of the deployment operation mentioned above. The charging operation of a pile 30 and the driving thereof are repeated for each pile 30 as mentioned above.

In this preferred embodiment, since the second leader boom 12 and pile 30 can be positioned in three dimensions, the barge 4 does not need to be re-positioned for driving piles of different rake angles. This arrangement saves construction time greatly.

Furthermore, since the piling rig 2 can be pivoted to a horizontal position and the pile 30 can be charged thereto in the horizontal position, no bending moment is exerted on the pile 30 during the charging operation and damage to the pile 30 can be avoided.

Furthermore, in another preferred embodiment, the piling rig 2 may be mounted on a skid boom (not shown). The entire piling rig 2 may then be moved with respect to the piling barge 4. Therefore, the location of the pile 30 to be driven can be adjusted to the predetermined location without moving the piling barge 4 itself.

The present invention has thus been shown and described with reference to specific embodiments. However, it should be noted that the present invention is in no way limited to the details of the described arrangements but changes and modifications may be made without departing from the scope of the appended claims.

For example, although, in the above preferred embodiment, the piling rig 2 is mounted on the piling barge 4, in case of using the piling rig 2 on the ground, it may be mounted on a vehicle such as a truck.

According to the present invention, it provides a piling rig that prevents damage to a pile during the charging operation and enables to reduce overall time required to charge each pile to the leader boom.

The foregoing describes the invention including a preferred form thereof. Alterations and modifications as will be obvious to those skilled in the art are intended to be incorporated within the scope hereof.

**CLAIMS:**

1. A piling rig carried on a barge comprising:

5 a first leader boom adapted for pivotal movement in a plane parallel to said barge;

means for rotating the first leader boom between a substantially horizontal position and an upright position;

10 a second leader boom supported by said first leader boom and adapted for pivotal movement with respect to said first leader boom in a plane perpendicular to said barge;

said second leader boom being provided with clamping means for securing a pile charged thereto during movement of said leader booms and hammer means for driving the pile.

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2. A piling rig as claimed in claim 1 further comprising a lifting frame for rotating said leader booms between said substantially horizontal position and an intermediate position that is between said substantially horizontal position and said upright position.

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3. A piling rig as claimed in claim 2 further comprising at least one power cylinder for rotating said leader booms with respect to said sub-frame between said intermediate position and said upright position.

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4. A piling rig as claimed in any one of the preceding claims further comprising a skid boom, on which said leader booms are mounted, said skid booms being movable to an outwardly extended position from said barge.

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