

A pile upending and lifting tool, an assembly of a pile upending tool and a supporting carriage and an assembly of a pile upending tool and a cradle

The present invention relates to a pile upending tool.

A pile upending tool is known in the prior art. Under operating conditions the known pile upending tool is stabbed into a monopile which is stored horizontally on board of a vessel. After stabbing the pile upending tool into the monopile, the pile upending tool is fastened to an end portion of the monopile. Subsequently, the pile upending tool is raised until the monopile achieves a vertical orientation. After that, the monopile can be driven into a seabed by means of a pile driver.

An object of the invention is to provide an improved pile upending tool.

This object is accomplished with the pile upending tool according to the invention which comprises a hoisting element for being mounted to a hoisting cable, a lifting body including at least two fixation members for temporarily fixing a monopile, which fixation members are located at a distance from each other, a first link which is pivotally coupled to the hoisting element through a first hoisting element pivot and to the lifting body through a first lifting body pivot, a second link which is pivotally coupled to the hoisting element through a second hoisting element pivot and to the lifting body through a second lifting body pivot being located at a distance from the first lifting body pivot, wherein the second link is adaptable such that pivot axes of the second hoisting element pivot and the second lifting body pivot are mutually displaceable between a first relative position and a second relative position, wherein in the first relative position an angle between a plane through pivot axes of the first hoisting element pivot and the first lifting body pivot and a plane through the pivot axes of the first lifting body pivot and the second lifting body pivot is different than in the second relative position.

An advantage of the pile upending tool according to the invention is that it can lift a monopile through the first link and simultaneously rotating the monopile by rotating the lifting

body with respect to the first link through adapting the distance between the pivot axes of the second hoisting element pivot and the second lifting body pivot.

The pile upending tool may be configured such that the lifting body rotates substantially 90° about the first lifting body pivot when moving the pivot axes of the second hoisting element pivot and the second lifting body pivot from the first to the second relative position. This means that a monopile can be lifted and rotated from a horizontal to a vertical orientation when the fixation members are fastened to the monopile.

The hoisting element, the lifting body, the first and second links and the first and second fixation members may lie in a common plane, both in the first relative position and the second relative position.

The second link may be movable such that the pivot axes of the second hoisting element pivot and the second lifting body pivot are mutually displaceable between a first relative position and a second relative position.

In an embodiment, in the second relative position the distance between the pivot axes of the second hoisting element pivot and the second lifting body pivot is larger than in the first relative position. This means that under operating conditions, when the fixation members are fastened to a horizontally positioned monopile the first lifting body pivot will lie below the second lifting body in the first relative position.

In an embodiment, in the first relative position the first link and the lifting body are folded to each other and in the second relative position the first link and the lifting body are unfolded with respect to each other. This provides a compact structure in the first relative position.

The second link may be articulated, including a first part and a second part which are pivotally coupled to each other through a second link pivot including a pivot axis. This is a relatively simple structure of the adaptable second link.

The geometry of the second link may be selected such that in the first relative position the first part and the second part are folded to each other such that the first part

and the second part at least partly overlap each other. This provides a compact structure in the first relative position.

In the first relative position the first link and the first part of the second link may at least partly overlap each other.

The geometry of the second link may be selected such that in the second relative position the pivot axes of the second hoisting element pivot, the second lifting body pivot and the second link pivot lie in a plane whereas the pivot axis of the second link pivot is located between the pivot axes of the second hoisting element pivot and the second lifting body pivot. This provides the opportunity to distribute hoisting forces on the lifting body evenly through the first link and the second link.

In an embodiment, under operating conditions when the hoisting element is lifted and the first and second links are suspended from the hoisting element, in the first relative position the pivot axes of the first hoisting element pivot and the first lifting body pivot lie in a substantially vertical plane.

In an embodiment in the first relative position at least one of the pivot axis of the second link pivot and the pivot axis of the second lifting body pivot lies at a distance from the plane. This facilitates unfolding of the first and second parts of the second link upon lifting a monopile when the first and second members are fastened to the monopile.

In a particular embodiment the pivot axes of the first and second hoisting element pivots coincide.

The first link may be a rigid first link.

Preferably, the fixation members are displaceable with respect to each other, since this provides the opportunity to adapt their mutual positions to the size of a monopile.

At least one of the fixation members may comprise an engaging element which is movable with respect to the lifting body in order to be inserted into a hole of a monopile so as to engage the monopile. The engaging element may be an elongated finger which fits through a through-hole in a circumferential wall of a monopile.

The at least one of the fixation members may be provided with a wedge which is movable with respect to the engaging element for being inserted into a space between the engaging element and an edge of the hole. Due to the presence of
5 the wedge any play between the engaging element and the edge of the hole can be eliminated.

The pile upending tool may comprise a rotation device for rotating the pile upending tool about a centreline of the monopile when the pile upending tool contacts a monopile in the
10 first relative position of the pivot axes of the second hoisting element pivot and the second lifting body pivot. This provides the opportunity to position the fixation members at desired locations at the circumference of the monopile prior to fasten them to the monopile. For example, if one of the fixation
15 members is provided with an engaging element as described hereinbefore the rotation device can serve to align the engaging element with the corresponding hole of a monopile.

In an embodiment the rotation device comprises a pin which is movable with respect to the lifting body in order to be
20 inserted into a hole of a monopile so as to engage the monopile and an actuator for subsequently rotating the pile upending tool with respect to the monopile, wherein the actuator engages the pin and the lifting body. This means that the actuator can apply a force on the lifting body and the pin which in turn has a
25 fixed position with respect to the monopile.

The pile upending tool may have a locking member for locking the first link with respect to the lifting body when the pivot axes of the second hoisting element pivot and the second lifting body pivot are in the first relative position. This
30 provides the opportunity to handle the pile upending tool in a stable compact configuration, for example storing it in an arbitrarily orientation, without the risk of automatically moving the pivot axes of the second hoisting element pivot and the second lifting body pivot to their second relative position.

35 The pile upending tool may comprises an actuator for rotating the first link and the lifting body with respect to each other. For example, the actuator may be operated to fold the first link and the lifting body to each other, i.e. when mutually moving the pivot axes of the second hoisting element

pivot and the second lifting body pivot from the second relative position to the first relative position.

In a practical embodiment, under operating conditions when the hoisting element is lifted and the first and second
5 links are suspended from the hoisting element, the fixation members lie above each other in the first relative position, wherein in the second relative position respective imaginary lines through the pivot axes of the first hoisting element pivot and the first lifting body pivot, through the pivot axes of the
10 second hoisting element pivot and the second lifting body pivot and through the pivot axes of the first and second lifting body pivots form a triangle of which the imaginary line through the pivot axes of the first and second lifting body pivots forms a basis, and the fixation members lie at a distance from each
15 other in horizontal direction. This configuration may provide an even distribution of lifting force on the lifting body in the second relative position.

At least one of the first hoisting element pivot, the first lifting body pivot, the second hoisting element pivot and
20 the second lifting body pivot may be provided with a spherical bearing for transferring a force in longitudinal direction of its pivot axis. This may at least partially compensate a side load on the at least one of said pivots.

The invention is also related to an assembly of a pile
25 upending tool as described above and a supporting carriage for supporting the pile upending tool when the pivot axes of the second hoisting element pivot and the second lifting body pivot are in the first relative position, wherein the supporting carriage is movable in horizontal direction when it is supported
30 on a surface. Under operating conditions when the first and second links are suspended from the hoisting element, in the first relative position the fixation members will be located above each other, which provides the opportunity to move and engage them to a horizontal monopile by displacing the
35 supporting carriage including the pile upending tool in horizontal direction on the surface. The surface may be deck of a vessel and the supporting carriage may be displaceable in alignment with a monopile to be upended.

The invention is also related to an assembly of a pile upending tool as described above and a cradle for supporting the pile upending tool when it is out-of-use.

The cradle may be configured to support the pile
5 upending tool in a condition in which the pivot axes of the second hoisting element pivot and the second lifting body pivot are in the first relative position and the fixation members lie at a distance from each other in horizontal direction. For example, the cradle may support the pile upending tool at the
10 first lifting body pivot and at one of the fixation members which is located at a distance from the first lifting body pivot.

The invention will hereafter be elucidated with reference to very schematic drawings showing an embodiment of
15 the invention by way of example.

Fig. 1 is a perspective view of an embodiment of a pile upending tool according to the invention.

Fig. 2 is a sectional view of the pile upending tool according to Fig. 1, illustrating a first condition thereof.

20 Fig. 3 is a side view of the pile upending tool according to Fig. 1, illustrating a second condition thereof.

Fig. 4 is a similar view as Fig. 3, illustrating an intermediate condition between the first and second conditions.

25 Fig. 5 is a perspective view of the embodiment as shown in Fig. 1 being supported by a supporting carriage.

Fig. 6 is a side view of the embodiment as shown in Fig. 5.

Figs. 7 and 8 are similar views as Fig. 7, illustrating receipt of the pile upending tool by a cradle.

30 Fig. 9 is an enlarged perspective view of a section of the embodiment as shown in Fig. 1.

Fig. 10 is a enlarged view of a part of the embodiment as shown in Fig. 1, showing an alignment system of the pile upending tool.

35 Fig. 11 is a similar view as Fig. 10, showing the alignment system in a different condition.

Fig. 1 shows an embodiment of a pile upending tool 1 according to the invention. The pile upending tool 1 can be used on a vessel and serves to lift an end portion of a monopile 2 of

which an opposite end portion rests on a support that in turn is pivotally mounted to the vessel (not shown). Under operating conditions the pile upending tool 1 lifts the monopile 2 such that it is turned to a vertical orientation, after which it can
5 be positioned onto the seabed and driven into the seabed by a pile driver (not shown).

The pile upending tool 1 comprises a hoisting element 3 which can be mounted to a hoisting cable of a crane (not shown). The hoisting element 3 is provided with a central opening 4 for
10 receiving a coupling element that is fixed to the hoisting cable. The pile upending tool 1 also comprises a lifting body 5 in the form of a rigid beam to which a first fixation member 6 and a second fixation member 7 are mounted. The first and second
15 fixation members 6, 7 are located at a distance from each other such that they can be temporarily fastened to the monopile 2 at opposite sides of the monopile 2 in radial direction thereof.

The pile upending tool 1 has a rigid first link 8 which is pivotally coupled to the hoisting element 3 through a first hoisting element pivot 9 and to the lifting body 5 through a
20 first lifting body pivot 10. The first link 8 includes two parallel rods 11 which are fixed to each other through parallel plates 12, but alternative configurations are possible.

The pile upending tool 1 has a second link 13 which is pivotally coupled to the hoisting element 3 through a second
25 hoisting element pivot 14 and to the lifting body 5 through a second lifting body pivot 15. The second lifting body pivot 15 is located at a distance from the first lifting body pivot 10. Pivot axes of the first and second hoisting element pivots 9, 14 coincide in the embodiment as shown in Fig. 1.

30 The second link 13 is articulated. It has a rigid first part 16 and a rigid second part 17 which are pivotally coupled to each other through a second link pivot 18. The first part 16 has parallel rods which are connected to opposite sides of the hoisting element 3. The second part 17 has parallel rods which
35 are connected to opposite sides of the lifting body 5. Since the first part 16 and the second part 17 are rotatable with respect to each other the articulated second link 13 is adaptable such that pivot axes of the second hoisting element pivot 14 and the second lifting body pivot 15 are mutually displaceable between a

first relative position in a first condition of the pile
upending tool 1 and a second relative position in a second
condition of the pile upending tool 1. Figs. 2 and 3 show the
first condition and the second condition, respectively, whereas
5 Fig. 4 shows an intermediate condition between the first and
second conditions. It is noted that in Fig. 2 the hoisting
element 3 is not shown for clarity reasons.

In the first condition as shown in Fig. 2 the pile
upending tool 1 can be fixed to the monopile 2 through the first
10 and second fixation members 6, 7 when the monopile 2 is in its
horizontal position. The geometry of the second link 13 is
selected such that in the first condition the first part 16 and
the second part 17 are folded to each other such that the first
part 16 and the second part 17 partly overlap each other,
15 whereas the first link 8 and the first part 16 also partly
overlap each other. This provides a compact structure in the
first condition. An imaginary first plane through a pivot axis
of the first lifting body pivot 10 and the common pivot axis of
the first and second hoisting element pivots 9, 14 is
20 substantially vertical.

Fig. 2 shows that in the first condition the first and
second fixation members 6, 7 lie above each other, in this case
in an imaginary substantially vertical second plane. The first
and second planes extend substantially parallel to each other in
25 the first condition. A pivot axis of the second lifting body
pivot 18 lies between the first and second planes, whereas the
pivot axis of the second lifting body pivot 15 lies between the
second lifting body pivot 18 and the second plane.

When lifting the hoisting element 3 the end portion of
30 the monopile 2 to which the first and second fixation members 6,
7 are fastened will be lifted, mainly through the first link 8.
Due to the locations of the pivot axes of the second link pivot
18 and the second lifting body pivot 15 in the first condition,
the second part 17 will rotate with respect to the first part 16
35 about the second link pivot 18 allowing the monopile 2 to rotate
towards a vertical orientation. In other words, the second link
13 will unfold during lifting the hoisting element 3, whereas
the lifting body 5 simultaneously unfolds with respect to the
first link 8.

In the intermediate condition the first link 8 will extend vertically, see Fig. 4. The vertical orientation of the monopile 2 is reached in the second condition as shown in Fig. 3. In the second condition respective imaginary lines through the pivot axes of the first hoisting element pivot 9 and the first lifting body pivot 10, through the pivot axes of the second hoisting element pivot 14 and the second lifting body pivot 15 and through pivot axes of the first and second lifting body pivots 10, 15 form a triangle, whereas the first and second fixation members 6, 7 lie at a distance from each other in horizontal direction. In the second condition the first and second hoisting element pivots 9, 14 are located above and between the first and second fixation members 6, 7. The geometry of the second link 13 is such that in the second condition the pivot axes of the second hoisting element pivot 14, the second lifting body pivot 15 and the second link pivot 18 lie in a plane whereas the pivot axis of the second link pivot 18 is located between the pivot axes of the second hoisting element pivot 14 and the second lifting body pivot 15.

Figs. 2-4 illustrate that in the second condition and the intermediate condition of the pile upending tool 1 the distance between the pivot axes of the second hoisting element pivot 14 and the second lifting body pivot 15 is larger than in its first condition. In more general terms, in the first relative position the first link 8 and the lifting body 5 are folded to each other and in the second relative position an angle between a plane through the pivot axes of the first hoisting element pivot 9 and the first lifting body pivot 10 and a plane through the pivot axes of the first and second lifting body pivots 10, 15 is larger than in the first relative position.

When lifting a monopile 2 as illustrated in Figs. 2-4 unfolding of the first link 8 and the lifting body 5 will occur automatically. However, for example for changing the pile upending tool 1 from the second to the first condition when the fixation members 6, 7 are not in engagement with a monopile 2 the pile upending tool 1 may be provided with an actuator (not shown). The actuator may be functionally positioned between the

first part 16 of the second link 13 and the first link 8, for example.

Figs. 2 and 3 show that when the pile upending tool 1 is changed from its first condition to its second condition, i.e. from the first to the second relative position, the lifting body 5 rotates 90° about the first lifting body pivot 10, which means that the fixation members 6, 7 also rotate from a mutual vertical position to a mutual horizontal position.

Figs. 5 and 6 show the pile upending tool 1 in its first condition when it is supported by a supporting carriage 19. The supporting carriage 19 is movable in horizontal direction along a guide 20 which may be fixed to the vessel and which is aligned with the monopile 2 to be upended. The supporting carriage 19 may be adapted such that under operating conditions the heights of the first and second fixation members 6, 7 substantially match to opposite sides of a monopile 2 in radial direction, to which sides the first and second fixation members 6, 7 must be fastened. This illustrated in Fig. 6.

Figs. 7 and 8 show an embodiment of a cradle 21 for storing the pile upending tool 1 in a sea fastening manner when it is out-of-use. The cradle 21 may be fixed to the vessel. The pile upending tool 1 is provided with a locking member 22 for locking the pile upending tool 1 in its first condition. The locking member 22 may lock the first link 8 and the upper part 16 of the second link 13 to each other, for example. Furthermore, the pile upending tool 1 has protrusions 23 which can be received in a pair of receiving elements 24 of the cradle 21. In this case the protrusions 23 are extensions at the first lifting body pivot 10, but they may be provided at a different location. The pile upending tool 1 is further supported by an upwardly extending bearing element 25 which can receive the second fixation member 7. The pile upending tool 1 can be secured to the cradle 21 through auxiliary locking means 26.

As described hereinbefore, the first and second fixation members 6, 7 are mounted to the lifting body 5. Each of the first and second fixation members 6, 7 are provided with a series of fingers 27 which fit in corresponding through-holes 28 of a monopile 2. The fingers 27 and through-holes 28 can be seen in Figs. 9-11 which show a part of the second fixation member 7.

The first fixation member 6 is provided with similar fingers 27. The through-holes 28 are located at a distance from each other in circumferential direction at an axial end of the monopile 2. The fingers 27 can be moved with respect to the lifting body 5 in radial direction of the monopile 2 between respective retracted and extended positions through a pushing beam 29, which in turn is mounted to hydraulic cylinders 30. On top of each of the fingers 27 is a hydraulic cylinder 32 for moving a wedge 33 between an upper side of the finger 27 and an upper edge of the corresponding through-hole 28. In this way, any play between the fingers 27 and the monopile 2, for example due to manufacturing tolerances, can be eliminated. Consequently, an evenly distributed force transfer between the monopile 2 and the first and second fixation members 6, 7 can be achieved.

Referring to Figs. 1-4 the first fixation member 6 is movably mounted to the lifting body 5 through parallelogram linkages 34, which allow the first fixation member 6 to move with respect to the second fixation member 7 in longitudinal direction of the lifting body 5, i.e. in radial direction of the monopile 2 upon approaching the monopile 2 as illustrated in Fig. 6, for example.

Figs. 10 and 11 show an alignment system in the form of a rotation device at the second fixation member 7, which rotation device serves to rotate the pile upending tool 1 in circumferential of a monopile 2 when the fingers 27 of the first and second fixation members 6, 7 are still in their retracted positions and align them to the corresponding through-holes 28 in the monopile 2. After aligning, the fingers 27 can be extended by activating the cooperating hydraulic cylinders 30. The rotation device is provided with a pin 35 which fits in a through-hole 28 of the monopile 2. Fig. 10 shows the pin 35 in a retracted condition and Fig. 11 shows the pin 35 in an extended condition. The pin 35 is movable between its retracted and extended conditions by means of a hydraulic cylinder 36. In order to align the pin 35 with the corresponding through-hole 28 the rotation device is provided with a pair of hydraulic cylinders 37 which can move the pin 35 along an inner circumference of the monopile 2. When the pin 35 and the through-hole 28 are aligned and the pin 35 has been passed

through the through-hole 28 the lifting body 5 is movable with respect to the monopile 2 through operating the pair of hydraulic cylinders 37. As a consequence, the pile upending tool 1 can rotate about a centreline of the monopile 2 until the
5 fingers 27 of the first and second fixation members 6, 7 are aligned with the corresponding through-holes 28. After that, the fingers 27 can be inserted into the corresponding through-holes 28 of the monopile 2 and the wedges 33 can be displaced with respect to the fingers 27 prior to start lifting the hoisting
10 element 3.

The invention is not limited to the embodiment shown in the drawings and described hereinbefore, which may be varied in different manners within the scope of the claims and their technical equivalents. For example, the second link may have an
15 alternative configuration than having mutually pivotable first and second parts.

CLAIMS

1. A pile upending tool (1), comprising a hoisting element (3) for being mounted to a hoisting cable, a lifting body (5) including at least two fixation members (6, 7) for temporarily fixing a monopile (2), which fixation members (6, 7) are located at a distance from each other, a first link (8) which is pivotally coupled to the hoisting element (3) through a first hoisting element pivot (9) and to the lifting body (5) through a first lifting body pivot (10), a second link (13) which is pivotally coupled to the hoisting element (3) through a second hoisting element pivot (14) and to the lifting body (5) through a second lifting body pivot (15) being located at a distance from the first lifting body pivot (10), wherein the second link (13) is adaptable such that pivot axes of the second hoisting element pivot (14) and the second lifting body pivot (15) are mutually displaceable between a first relative position and a second relative position, wherein in the first relative position an angle between a plane through pivot axes of the first hoisting element pivot (9) and the first lifting body pivot (10) and a plane through the pivot axes of the first lifting body pivot (10) and the second lifting body pivot (15) is different than in the second relative position.

2. A pile upending tool (1) according to claim 1, wherein in the second relative position the distance between the pivot axes of the second hoisting element pivot (14) and the second lifting body pivot (15) is larger than in the first relative position.

3. A pile upending tool (1) according to claim 2, wherein in the first relative position the first link (8) and the lifting body (5) are folded to each other and in the second relative position the first link (8) and the lifting body (5) are unfolded with respect to each other.

4. A pile upending tool (1) according to any one of the preceding claims, wherein the second link (13) is articulated, including a first part (16) and a second part (17) which are pivotally coupled to each other through a second link pivot (18) including a pivot axis.

5. A pile upending tool (1) according to claim 4, wherein the geometry of the second link (13) is selected such that in the first relative position the first part (16) and the second part (17) are folded to each other such that the first
5 part (16) and the second part (17) at least partly overlap each other.

6. A pile upending tool (1) according to claim 4 or 5, wherein in the first relative position the first link (8) and the first part (16) of the second link (13) at least partly
10 overlap each other.

7. A pile upending tool (1) according to any one of the claims 4-6, wherein the geometry of the second link (13) is selected such that in the second relative position the pivot axes of the second hoisting element pivot (14), the second
15 lifting body pivot (15) and the second link pivot (18) lie in a plane whereas the pivot axis of the second link pivot (18) is located between the pivot axes of the second hoisting element pivot (14) and the second lifting body pivot (15).

8. A pile upending tool (1) according to any one of the preceding claims, wherein under operating conditions when the hoisting element (3) is lifted and the first and second links (8, 13) are suspended from the hoisting element (3), in the first relative position the pivot axes of the first hoisting element pivot (9) and the first lifting body pivot (10) lie in a
20 substantially vertical plane.

9. A pile upending tool (1) according to claim 8 and any one of the claims 4-7, wherein in the first relative position at least one of the pivot axis of the second link pivot (18) and the pivot axis of the second lifting body pivot (15)
30 lies at a distance from the plane.

10. A pile upending tool (1) according to any one of the preceding claims, wherein the pivot axes of the first and second hoisting element pivots (9, 14) coincide.

11. A pile upending tool (1) according to any one of the preceding claims, wherein the first link (8) is a rigid
35 first link.

12. A pile upending tool (1) according to any one of the preceding claims, wherein the fixation members (6, 7) are displaceable with respect to each other.

13. A pile upending tool (1) according to any one of the preceding claims, wherein at least one of the fixation members (6, 7) comprises an engaging element (27) which is movable with respect to the lifting body (5) in order to be
5 inserted into a hole (28) of a monopile (2) so as to engage the monopile (2).

14. A pile upending tool (1) according to claim 13, wherein the at least one of the fixation members (6, 7) is provided with a wedge (33) which is movable with respect to the
10 engaging element (28) for being inserted into a space between the engaging element (28) and an edge of the hole (28).

15. A pile upending tool (1) according to any one of the preceding claims, wherein the pile upending tool (1) comprises a rotation device (35, 36, 37) for rotating the pile
15 upending tool (1) about a centreline of the monopile (2) when the pile upending tool (1) contacts a monopile (2) in the first relative position of the pivot axes of the second hoisting element pivot (14) and the second lifting body pivot (15).

16. A pile upending tool (1) according to claim 15, wherein the rotation device comprises a pin (35) which is
20 movable with respect to the lifting body (5) in order to be inserted into a hole (28) of a monopile (2) so as to engage the monopile (2) and an actuator (37) for subsequently rotating the pile upending tool (1) with respect to the monopile (2), wherein
25 the actuator (37) engages the pin (35) and the lifting body (5).

17. A pile upending tool (1) according to any one of the preceding claims, wherein the pile upending tool (1) has a locking member (22) for locking the first link (8) with respect
30 to the lifting body (5) when the pivot axes of the second hoisting element pivot (14) and the second lifting body pivot (15) are in the first relative position.

18. A pile upending tool (1) according to any one of the preceding claims, wherein the pile upending tool (1) comprises an actuator for rotating the first link (8) and the
35 lifting body (5) with respect to each other.

19. A pile upending tool (1) according to any one of the preceding claims, wherein under operating conditions when the hoisting element (3) is lifted and the first and second links (8, 13) are suspended from the hoisting element (3), the

fixation members (6, 7) lie above each other in the first relative position, wherein in the second relative position respective imaginary lines through the pivot axes of the first hoisting element pivot (9) and the first lifting body pivot (10), through the pivot axes of the second hoisting element pivot (14) and the second lifting body pivot (15) and through the pivot axes of the first and second lifting body pivots (10, 15) form a triangle of which the imaginary line through the pivot axes of the first and second lifting body pivots (10, 15) forms a basis, and the fixation members (6, 7) lie at a distance from each other in horizontal direction.

20. A pile upending tool (1) according to any one of the preceding claims, wherein at least one of the first hoisting element pivot (9), the first lifting body pivot (10), the second hoisting element pivot (14) and the second lifting body pivot (15) is provided with a spherical bearing for transferring a force in longitudinal direction of its pivot axis.

21. An assembly of a pile upending tool (1) according to any one of the preceding claims and a supporting carriage (19) for supporting the pile upending tool (1) when the pivot axes of the second hoisting element pivot (14) and the second lifting body pivot (15) are in the first relative position, wherein the supporting carriage (19) is movable in horizontal direction when it is supported on a surface (20).

22. An assembly of a pile upending tool (1) according to any one of the claims 1-20 and a cradle (21) for supporting the pile upending tool (1) when it is out-of-use.

23. An assembly according to claim 22 and dependent on claim 17, wherein the cradle (21) is configured to support the pile upending tool (1) in a condition in which the pivot axes of the second hoisting element pivot (14) and the second lifting body pivot (15) are in the first relative position and the fixation members (6, 7) lie at a distance from each other in horizontal direction.

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