drilling members and the joint member to be fitted together to perform positioning, the cylindrical drilling members to be coupled will not be firmly united by the structure.

[0008]

Embodiments of the invention seek to provide a pile joint, a pile coupling structure, and a pile coupling method that allow firm uniting of piles to be coupled.

Means for solving the problems

[0009]

A pile joint according to an aspect of the invention is for coupling two piles, and the pile joint comprises: a tubular body into which each pile provided with a projection on a periphery thereof is inserted through an end of the body; and a fitting portion formed on the body so as to be fitted to the projection by the insertion and rotation of the pile, wherein the fitting portion is formed with: a first shape having a surface that is inclined so as to become distant from the end of the body as the surface extends in the direction of rotation of the pile; and a second shape for fitting between the projection and the pile, the second shape being formed in a direction intersecting a longitudinal direction of the pile.

[0010]

In this configuration, since the fitting portion is formed with the first shape having the surface that is inclined so as to become distant from the end of the body as the surface extends in the direction of rotation of the pile, inserting the pile into the pile joint and rotating the pile cause the pile to move in the direction of the insertion, that is to say, in the direction of the other pile to be coupled by the pile joint. As a result, ends of the two piles to be coupled come into contact with each other and the inclined surface of the fitting portion also comes into contact with a surface of the projection facing the inclined surface, which causes the two piles and the pile joint to be tightened up. The first shape formed in the fitting portion thus allows firm uniting of the two piles to be coupled and the pile joint.

[0011]

The fitting portion is also formed with the second shape for fitting between the projection and the pile, which produces the so-called wedge effect between the projection and the fitting portion and, for example, allows the prevention of slippage between the projection and the fitting portion which may occur when underground-installed piles are pulled out. The second shape formed in the fitting portion thus allows firm uniting of the piles and the pile joint.

[0012]

In the pile joint according to an embodiment of the invention, the fitting portion may be formed so that the second shape is formed on the surface forming the first shape. This configuration allows firmer uniting of the two piles to be coupled and the pile joint.

[0013]

In the pile joint according to an embodiment of the invention, the projection may have a planar shape, the inside of which is cut out. Welding the outer edge of the projection to provide the projection on the pile would produce a bead (weld mark) around the outer edge of the projection, and the bead might constitute an obstacle to the fitting between the projection and the fitting portion. This configuration allows a bead to be formed inside the

planar shape by welding the cut-out inside of the planar shape, and therefore can prevent a bead from constituting an obstacle to the fitting between the projection and the fitting portion.

[0014]

In the pile joint according to an embodiment of the invention, each pile may be provided with a plurality of projections, each identical to the projection, spaced at unequal angles in a direction of circumference, and the body may be formed with a plurality of fitting portions, each identical to the fitting portion, corresponding to the projections. A simple structure with this configuration allows coupled piles to be strengthened by providing the projections at positions in the cross-sectional direction where the piles require to be relatively strong.

[0015]

In the pile joint according to an embodiment of the invention, the body may be provided with a reinforcing member for covering at least each fitting portion. The strength of the body relatively decreases in an area where the fitting portion is formed, and this configuration allows the reinforcing member to enhance the decreased strength.

[0016]

The pile joint according to an embodiment of the invention may comprise a retaining member to be fixed to the reinforcing member and prevent each projection from disengaging from the fitting portion. Methods of fixing the retaining member to the reinforcing member in this configuration include, for example, bolting, and inserting a pin formed on the retaining member into a hole formed on the reinforcing member, which can reliably prevent the projection provided on the pile from disengaging from the fitting portion.

[0017]

In the pile joint of according to an embodiment the invention, the reinforcing member may be formed with a hole for checking that each projection is inserted into the fitting portion. This configuration allows an operator to visually check how the projection is inserted into the fitting portion even when the reinforcing member is provided.

[0018]

In the pile joint according to an embodiment of the invention, each fitting portion may be formed with a plurality of first shapes, each identical to the first shape, or a plurality of second shapes, each identical to the second shape, arranged in a direction of an axis of the piles. The formation of a plurality of the first or second shapes on each fitting portion in this configuration allows firm uniting of the piles to be coupled.

[0019]

In the pile joint according to an embodiment of the invention, one of the two piles may be to be installed underground, and the other pile may be to be used in an auxiliary manner for installing the one pile underground and may be positioned above the one pile. The other pile to be used to assist in installing the one pile underground is coupled by the pile joint in this configuration, so that the pile can be installed underground without being suspended.

[0020]

A pile coupling structure according to another aspect of the invention comprises: a pile provided with a projection on a periphery thereof; and a pile joint that has a tubular body into which the pile is inserted through an end of the body and which covers the periphery of the pile and comprises a fitting portion to be fitted to the projection by the insertion and rotation of the pile, the fitting portion being formed with: a first shape having a surface that is inclined so as to become distant from the end of the body as the surface extends in the direction of rotation of the pile; or a second shape for fitting

between the projection and the pile. This configuration allows firmer uniting of the two piles to be coupled and the pile joint.

[0021]

A pile coupling method according to another aspect of the invention is for coupling two piles by means of a pile joint that has a tubular body into which each pile provided with a projection on a periphery thereof is inserted through an end of the body and which covers the periphery of the pile and comprises a fitting portion to be fitted to the projection by the insertion and rotation of the pile, the fitting portion being formed with: a first shape having a surface that is inclined so as to become distant from the end of the body as the surface extends in the direction of rotation of the pile; or a second shape for fitting between the projection and the pile, wherein the pile coupling method has: a first step of installing one of the two piles underground; and a second step of standing the other pile above the underground-installed pile and rotating the other pile so that the two piles are fitted together by the pile joint. This configuration allows firmer uniting of the two piles to be coupled and the pile joint.

[0022]

A pile coupling method according to another aspect of the invention is for coupling a first pile and a second pile by means of a pile joint that has a tubular body into which each pile provided with a projection on a periphery thereof is inserted through an end of the body and which covers the periphery of the pile and comprises a fitting portion to be fitted to the projection by the insertion and rotation of the pile, the fitting portion being formed with: a first shape having a surface that is inclined so as to become distant from the end of the body as the surface extends in the direction of rotation of the pile; or a second shape for fitting between the projection and the pile, wherein the pile coupling method has: a first step of gripping the second pile with a second gripper comprised in a press-in machine; a second step of gripping the first pile with a first gripper comprised in the press-in machine; and a third step of moving the first gripper so that ends of the first and second piles come into contact with each other, rotating the first or second gripper, and thereby coupling the first and second piles by means of the pile joint. This configuration allows more reliable coupling of the two piles since the two piles are coupled together by the pile joint with the piles being gripped by the first and second grippers, respectively.

Advantage of the invention

[0023]

Embodiments of the invention allow firm uniting of piles to be coupled.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

Figure 1 is an external view of piles and a joint of a first embodiment, where (a) is a cross-sectional view of the joint, (b) is a side view of the joint, (c) is a cross-sectional view of one of the piles, and (d) is a side view of the piles;

Figure 2 shows a method of coupling the piles and joint of the first embodiment, where (a) is a step of inserting one of the piles into the joint, and (b) shows a step of rotating the pile with respect to the joint;

Figure 3 is an enlarged view showing a state in which keys and fitting portions of the first embodiment are

CLAIMS

1. A pile joint for coupling two piles, the pile joint comprising:

a tubular body into which each pile provided with a projection on a periphery thereof is inserted through an end of the body; and

a fitting portion formed on the body so as to be fitted to the projection by the insertion and rotation of the pile,

wherein the fitting portion is formed with: a first shape having a surface that is inclined so as to become distant from the end of the body as the surface extends in the direction of rotation of the pile; and a second shape for fitting between the projection and the pile, the second shape being formed in a direction intersecting a longitudinal direction of the pile.

2. The pile joint according to claim 1, wherein the fitting portion is formed so that the second shape is formed on the surface forming the first shape.

3. The pile joint according to claim 1 or 2,

wherein each pile is provided with a plurality of projections, each identical to the projection, spaced at unequal angles in a direction of circumference, and

wherein the body is formed with a plurality of fitting portions, each identical to the fitting portion, corresponding to the projections.

4. The pile joint according to any one of claims 1 to 3, wherein the body is provided with a reinforcing member for covering at least each fitting portion.

5. The pile joint according to claim 4, comprising a retaining member to be fixed to the reinforcing member and prevent each projection from disengaging from the fitting portion.

6. The pile joint according to claim 4 or 5, wherein the reinforcing member is formed with a hole for checking that each projection is inserted into the fitting portion.

7. The pile joint according to any one of claims 1 to 6, wherein each fitting portion is formed with a plurality of first shapes, each identical to the first shape, or a plurality of second shapes, each identical to the second shape, arranged in a direction of an axis of the piles.

8. A pile coupling structure comprising:

a pile provided with a projection on a periphery thereof; and

a pile joint that has a tubular body into which the pile is inserted through an end of the body and which covers the periphery of the pile and comprises a fitting portion to be fitted to the projection by the insertion and rotation of the pile, the fitting portion being formed with: a first shape having a

surface that is inclined so as to become distant from the end of the body as the surface extends in the direction of rotation of the pile; or a second shape for fitting between the projection and the pile.

9. The pile coupling structure according to claim 8, wherein the projection has a planar shape, the inside of which is cut out.

10. The pile coupling structure according to claims 8 or 9,

wherein one of two piles that are each identical to the pile and are to be coupled together by the pile joint is to be installed underground, and

wherein the other pile is to be used in an auxiliary manner for installing the one pile underground and is positioned above the one pile.

11. A pile coupling method for coupling two piles by means of a pile joint that has a tubular body into which each pile provided with a projection on a periphery thereof is inserted through an end of the body and which covers the periphery of the pile and comprises a fitting portion to be fitted to the projection by the insertion and rotation of the pile, the fitting portion being formed with: a first shape having a surface that is inclined so as to become distant from the end of the body as the surface extends in the direction of rotation of the pile; or a second shape for fitting between the projection and the pile,

wherein the pile coupling method has:

a first step of installing one of the two piles underground; and

a second step of standing the other pile above the underground-installed pile and rotating the other pile so that the two piles are fitted together by the pile joint.

12. A pile coupling method for coupling a first pile and a second pile by means of a pile joint that has a tubular body into which each pile provided with a projection on a periphery thereof is inserted through an end of the body and which covers the periphery of the pile and comprises a fitting portion to be fitted to the projection by the insertion and rotation of the pile, the fitting portion being formed with: a first shape having a surface that is inclined so as to become distant from the end of the body as the surface extends in the direction of rotation of the pile; or a second shape for fitting between the projection and the pile,

wherein the pile coupling method has:

a first step of gripping the second pile with a second gripper comprised in a press-in machine;

a second step of gripping the first pile with a first gripper comprised in the press-in machine; and

a third step of moving the first gripper so that ends of the first and second piles come into contact with each other, rotating the first or second gripper, and thereby coupling the first and second piles by means of the pile joint.