that some of the hole plugging bolts cannot be removed and the entire piles are therefore discarded inevitably.

[0009] In the method of connecting the arc-shaped plates by the arc-shaped-plate interconnecting fitting having a plate-like shape as illustrated in FIG. 14, there are problems in that, when significant bending moment acts on the joint part, the connecting fitting may be deformed, and that the shear strength of the connecting fitting in a direction orthogonal to an axial direction is smaller than that of a pile body.

[0010] Further, the connecting method has a problem in that torque transmission is unsatisfactory when the piles need to be driven while turning the piles.

[0011] ~~The~~ Embodiments of the present invention ~~has been made in view of the problems inherent in the related art, and has an object~~ seek to provide a weldless joint for piles, which ~~is~~ may be capable of achieving reduction in number of members to be used, reduction in cost, satisfactory workability, and high flexural and shear strengths, and ~~is~~ may also be capable of providing a mechanism of transmitting rotational torque at the same time.

Solution to Problems

[0012] ~~In order to solve the problems inherent in the related art as described above, the feature of the invention according to claim 1 resides in a~~ According to an aspect of the present invention, there is provided a weldless joint for piles, including: end fittings respectively arranged at joining end portions of piles to be connected

transmit a moment of rotation between the piles to be connected upright.

[0013] ~~In addition to the configuration according to claim 1, the feature of the invention according to claim 2 resides in that t~~The weldless joint for piles may further include~~s~~ an arc-shaped-plate interconnecting fitting having a plate-like shape, the arc-shaped-plate interconnecting fitting being fixed over outer surfaces of end portions of adjacent arc-shaped plates of the plurality of arc-shaped plates, to thereby connect the plurality of arc-shaped plates together, that the arc-shaped-plate interconnecting fitting has a tapered dovetail groove formed therein, the tapered dovetail groove having a dovetail-groove-shaped cross-section and being formed into such a tapered shape that any one of upper and lower sides of the tapered dovetail groove is narrow, that the adjacent arc-shaped plates include arc-shaped-plate interconnecting protrusions formed on the outer surfaces of the end portions thereof, respectively, the arc-shaped-plate interconnecting protrusions each having a shape obtained by vertically dividing in half a tapered dovetail shape that is fitted to the tapered dovetail groove, that the arc-shaped-plate interconnecting protrusions are inserted into the tapered dovetail groove so that the arc-shaped-plate interconnecting fitting connects the adjacent arc-shaped plates together, and that end portions of the arc-shaped-plate interconnecting fitting are screwed onto the adjacent arc-shaped plates.

[0014] ~~In addition to the configuration according to claim 1 or 2, the feature of the invention according to claim 3 resides in that t~~The shear ring fitting portions ~~are~~ may be formed into a groove shape in surfaces of the joining surfaces of the end fittings, respectively.

[0015] ~~In addition to the configuration according to claim 1 or 2, the feature of the invention according to claim 4 resides in that t~~The shear ring fitting portions ~~are~~ may each be formed into an annular shape obtained by shaving, in a stepped manner, a corner defined by the joining end surface and an inner peripheral rim surface of an end plate center opening formed in a center of each of the end fittings, and that the shear ring having the circular ring shape is fitted on the inner peripheral surface of the end plate center opening.

[0016] ~~In addition to the configuration according to claim 3 or 4, the feature of the invention according to claim 5 resides in that t~~The shear ring fitting portions of the end fittings ~~are~~ may each be formed into such a tapered shape that the bottom surface side is narrower than a joining surface opening side, and that upper and lower sides of an inner peripheral surface of the shear ring and upper and lower sides of an outer peripheral surface of the shear ring are each formed into a tapered shape conforming to each of the shear ring fitting portions.

[0017] ~~In addition to the configuration according to claim 1, the feature of the invention according to claim 6 resides in that~~

~~t~~The shear ring ~~is~~ may be formed integrally with one of the end fittings in a protruding manner so as to have such a trapezoid cross-section that a protruding end portion side is narrow, and that the shear ring is fitted in the shear ring fitting portion that is formed in another one of the end fittings so as to have a shape conforming to the trapezoid shape of the shear ring formed integrally with the one of the end fittings.

Advantageous Effects of Invention

[0018] ~~As described in claim 1, t~~The weldless joint for piles according to embodiment of the present invention includes: the end fittings respectively arranged at the joining end portions of the piles to be connected to each other; and the plurality of arc-shaped plates fitted over the end fittings so as to be arranged around the outer peripheries of the end fittings, the end fittings including the flange-shaped protruding threads formed integrally along the outer peripheries thereof, the plurality of arc-shaped plates including the recessed grooves formed in the inner peripheral surfaces thereof, the protruding threads of the end fittings being fitted in the recessed grooves, the piles being connected to each other by fitting the protruding threads in the recessed grooves so as to fit the plurality of arc-shaped plates on the outer peripheries of the end fittings.

The end fittings include the shear ring fitting portions having a circular ring shape, respectively, the shear ring fitting portions being formed in the joining surfaces of the end fittings, respectively,

and being arranged coaxially with the end fittings. The shear ring having a circular ring shape is interposed astride the shear ring fitting portions in the joining surfaces. The shear ring fitting portions each include the projection formed on the bottom surface thereof by partially heightening the bottom surface. The shear ring integrally includes the recess in which the projection is fitted, the recess being formed in each of the upper and lower surfaces of the shear ring at the position corresponding to the projection on the bottom surface. The projection on the bottom surface is fitted in the recess in the each of the upper and lower surfaces of the shear ring so that the shear ring and the end fittings are prevented from relatively moving in the circumferential direction, to thereby transmit a moment of rotation between the piles to be connected upright. With this, the shear ring is interposed between the end fittings of the piles to be connected to each other, ~~thereby increasing~~ which may increase the shear strength in the direction orthogonal to the axial direction and the strength of the joint part.

[0019] In addition, the fitting of the recesses and the projections may prevent~~s~~ the shear ring and the shear ring fitting portions from relatively moving in a rotational direction, ~~thereby~~ which may add~~ing~~ a torque transmitting function at the same time. As a result, multi-functional joint structure can be obtained with a smaller number of members.

[0020] ~~As described in claim 2, t~~The weldless joint for piles according to embodiment of the present invention further includes the

arc-shaped-plate interconnecting fitting having a plate-like shape and being configured to connect the adjacent arc-shaped plates together. The arc-shaped-plate interconnecting fitting has the tapered dovetail groove formed therein, and the tapered dovetail groove has a dovetail-groove-shaped cross-section and formed into such a tapered shape that any one of the upper and lower sides of the tapered dovetail groove is narrow. The adjacent arc-shaped plates include the arc-shaped-plate interconnecting protrusions formed on the outer surfaces of the end portions thereof, respectively, and the arc-shaped-plate interconnecting protrusions each have a shape obtained by vertically dividing in half the tapered dovetail shape that is fitted to the tapered dovetail groove. The arc-shaped-plate interconnecting protrusions are inserted into the tapered dovetail groove so that the arc-shaped-plate interconnecting fitting connects the adjacent arc-shaped plates together. Accordingly, unlike the related art, it ~~is~~ may be unnecessary to perform fastening work on a large number of screws. Further, the members are lightweight, and hence the piles can be connected together in a short period of time with good workability.

[0021] Further, both ends of the arc-shaped-plate interconnecting fitting are screwed onto the arc-shaped plates. Thus, when a bending force is applied to a connecting portion between the piles, component forces of separating the arc-shaped plates from each other are generated, whereas a force of outwardly warping the both ends of the arc-shaped-plate interconnecting fitting is

applied to the arc-shaped-plate interconnecting fitting. However, the warpage at this time is prevented through the screwing, and hence it is unnecessary to increase flexural strength of the arc-shaped-plate interconnecting fitting. As a result, the arc-shaped-plate interconnecting fitting can be formed into a thin fitting that is lightweight and easy to handle, ~~and is also~~ may reduced ~~in~~ protruding height from the outer peripheries of the piles.

[0022] ~~As described in claim 3, a~~According to embodiments of the present invention, the shear ring fitting portions are formed into the groove shape in the surfaces of the joining surfaces of the end fittings, respectively. Accordingly, the shear ring fitting portions can be easily formed by machining the disc-like end fittings using a lathe, whereas the shear ring can be easily formed by machining a circular ring material using a lathe.

[0023] ~~As described in claim 4, a~~According to embodiments of the present invention, the shear ring fitting portions are each formed into an annular shape obtained by shaving, in a stepped manner, the corner defined by the joining end surface and the inner peripheral rim surface of the end plate center opening formed in the center of each of the end fittings, and the shear ring having the circular ring shape is fitted on the inner peripheral surface of the end plate center opening. Accordingly, the shear ring fitting portions can be formed in the end fittings easily.

[0024] ~~As described in claim 5, a~~According to embodiments of the present invention, the shear ring fitting portions of the end fittings are

each formed into such a tapered shape that the bottom surface side is narrower than the joining surface opening side, and the upper and lower sides of the inner peripheral surface of the shear ring and the upper and lower sides of the outer peripheral surface of the shear ring are each formed into a tapered shape conforming to each of the shear ring fitting portions. Accordingly, when joining the end fittings of the upper and lower piles together, owing to the tapered grooves of the end fittings and the tapered shape of the shear ring, the piles ~~are~~ may be aligned automatically, ~~thereby~~ which may facilitat~~inge~~ high-precision joining of the piles.

[0025] ~~As described in claim 6, a~~According to embodiments of the present invention, the shear ring is formed integrally with one of the end fittings in a protruding manner so as to have such a trapezoid cross-section that the protruding end portion side is narrow, and the shear ring is fitted in the shear ring fitting portion that is formed in another one of the end fittings so as to have a shape conforming to the trapezoid shape of the shear ring formed integrally with the one of the end fittings. Accordingly, the shear ring is formed together with the end fitting when forming the end fitting, ~~thereby~~ which may reduc~~inge~~ the number of manufacturing steps, which leads to reduction in cost.

Brief Description of Drawings

[0026] FIG. 1 is a cross-sectional view illustrating an example of a weldless joint for piles according to the present invention.