

DESCRIPTION

5 **Title of the Invention:**
JOINT MECHANISM AND CONNECTION METHOD FOR STEEL
PIPE

Technical Field

10 [0001]

The present invention relates to a joint mechanism and a connection method for a steel pipe.

Background Art

15 [0002]

For forming a foundation pipe, a soil retaining sheet pile for a structure, an anti-landslide pile, a pier post, etc., a steel pipe pile is employed as an example of a steel pipe. In order to reach an inside of a support layer which is a solid ground present under a soft ground, a long steel pipe is required. However, for the sake of convenience of manufacture, transport etc., it has been practiced to carry a steel pipe pile manufactured in a factory and having a length ranging from a few meters to a few tens of meters to a site of its installment and to connect a plurality of such steel pipe piles vertically to each other one after another on the site to form an assembly having a required length.

25 [0003]

As a mechanism for connecting steel pipe piles as above, Patent Document 1 proposes a machine-based joint mechanism.

[0004]

30 With this joint mechanism, an inward circumferential groove of an outer fitting member and an outward circumferential groove of an inner fitting member are formed in advance to have a same groove width. Then, the inward circumferential groove and the outward circumferential groove are brought into opposition to each other when the outer fitting member and the inner fitting member are fitted to each other, and then a key member incorporated within the inward

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circumferential groove is pushed out toward the outward circumferential groove to realize fitting across and between the inward circumferential grove and the outward circumferential groove. As a result, a pair of steel pipe piles are connected not to be movable relative to each other along a longitudinal direction of these steel pipe piles.

Background Art Document

[Patent Document]

[0005]

10 [Patent Document 1] Japanese Patent No. 3158081

Summary of the Invention

Problem to be Solved by Invention

[0006]

15 However, the above-described arrangement wherein a key member is incorporated in advance within the inward circumferential groove to be pushed out toward the outward circumferential groove at the time of connection tends to be complicated. Further, as the inward circumferential groove needs to be formed with a groove width capable of
20 accommodating the key member entirely, the thickness of the outward fitting member is increased correspondingly.

[0007]

25 The present invention has been made in view of the above-described state of the art and its object is to simplify an arrangement for connecting a pair of steel pipes and to achieve cost reduction also.

[Solution]

[0008]

30 According to a first characterizing feature of a joint mechanism relating to the present invention, a joint mechanism for a steel pipe comprises:

- a first inner joint provided at one end of one steel pipe;
- a second inner joint provided at the other end of the other steel
35 pipe;
- an outer joint disposed circumferentially between and across the

first inner joint and the second inner joint for connecting a pair of the steel pipes to each other when the first inner joint of one steel pipe is placed adjacent the second inner joint of the other steel pipe;

5 an engaging portion provided in one of an outer circumference of the first inner joint and the second inner joint respectively and an inner circumference of the outer joint; and

10 an engaged portion provided in the other of the outer circumference and the inner circumference to be engaged with the engaging portion for preventing relative movement between the pair of steel pipes along a longitudinal direction of these steel pipes;

wherein the outer joint comprises a plurality of unit members disposed side by side around the first inner joint and the second inner joint;

15 the plurality of unit members include a standard unit member having engaging projecting portions at an end portion thereof on the first inner joint side and an end portion thereof on the second inner joint side, respectively;

20 the first inner joint and the second inner joint respectively has an engaging sunk portion engageable with the engaging projecting portion for preventing detachment of the standard unit member to the outside; and

25 at least a portion of a wall face constituting the engaging sunk portion includes a cutout portion capable of inserting the engaging projecting portion of the standard unit member to a position corresponding to the engaging sunk portion.

[0009]

30 When the first inner joint provided at one end of one steel pipe and the second inner joint provided at the other end of the other steel pipe are placed adjacent each other and the outer joint is placed circumferentially across and between these first inner joint and second inner joint, the standard unit member having engaging projecting portions at an end portion thereof on the first inner joint side and an end portion thereof on the second inner joint side, respectively is inserted via the cutout portion, so that the engaging portion and the engaged portion
35 can be engaged with each other.

Via the cutout portion, the standard unit member placed

circumferentially across and between the first inner joint and the second inner joint will be disposed at a predetermined position of the first inner joint and the second inner joint respectively in association with a sliding operation of the engaging projecting portion in the circumferential direction of the steel pipes along the engaging sunk portions provided in the first inner joint and the second inner joint with maintaining the engagement between the engaging portion and the engaged portion.

If the outer joint is comprised of a plurality of unit members of a size allowing hand pickup thereof by a worker, a lifting operation by a machine such as a crane can be omitted, so that work efficiency for steel pipe connection can be improved.

Accordingly, there is no need for providing such arrangement provided by the conventional joint mechanism in which a key member as an engaging portion is incorporated in advance e.g. within the inward circumferential groove and then pushed out toward the outward circumferential groove. Consequently, the thickness of the outer joint can be reduced and material cost can be reduced correspondingly. Moreover, as the first inner joint and the second inner joint can be provided with an identical shape, reduction of processing cost can be realized also.

[0010]

According to a second characterizing feature of the present invention, the plurality of unit members further include a closing unit member having a shape to be in flush with an outer circumferential face around the cutout portion when this closing unit member is disposed within the cutout portion, and there is provided a fixing mechanism for fixing the closing unit member to at least the first inner joint or the second inner joint.

[0011]

When the closing unit member is fixed to the first inner joint and the second inner joint, the cutout portion is closed and also relative movement in the circumferential direction between the first inner joint and the second inner joint which are connected to each other via the outer joint is prevented.

[0012]

According to a third characterizing feature of the present

invention, the cutout portion includes a first cutout portion provided in the first inner joint and a second cutout portion provided in the second inner joint; and

the first inner joint and the second inner joint respectively includes a positioning mechanism for positioning the first cutout portion and the second cutout portion in fixed opposition to each other along the longitudinal direction of the steel pipes when the first inner joint of one steel pipe is placed adjacent the second inner joint of the other steel pipe for connection of the pair of steel pipes to each other.

[0013]

When the pair of steel pipes are to be connected to each other, thanks to the positioning mechanism, the first cutout portion and the second cutout portion can be easily brought into fixed opposition to each other along the longitudinal direction of the steel pipes.

[0014]

According to a fourth characterizing feature of the present invention, the positioning mechanism comprises a hole portion provided in a mutually opposing face of the first inner joint and the second inner joint respectively and a positioning pin to be inserted into the hole portion.

[0015]

Through the simple arrangement consisting essentially of a hole portion provided in a mutually opposing face of the first inner joint and the second inner joint respectively and a positioning pin to be inserted into the hole portion, reliable positioning arrangement can be realized cost-efficiently.

[0016]

According to a fifth characterizing feature of the present invention, the engaged portion comprises an outward circumferential groove provided in an outer circumference of the first inner joint and the second inner joint respectively; and

the engaging portion comprises an inward key portion provided in an inner circumference of the outer joint and engageable with the outward circumferential groove for preventing the relative movement between the pair of steel pipes in the longitudinal direction thereof.

[0017]

Since the above arrangement is a simple arrangement of engagement provided between an inward key portion and an outward circumferential groove, this can eliminate the need for incorporating a key member within an inward circumferential groove in advance as required by the conventional joint mechanism, so that the thickness of the outer joint can be reduced and the material cost can be reduced correspondingly. Moreover, as the first inner joint and the second inner joint can be provided with an identical shape, reduction of processing cost can be realized also.

[0018]

According to a sixth characterizing feature of the present invention, the engaging portion comprises an outward key portion provided in an outer circumference of the first inner joint and the second inner joint respectively; and

the engaged portion comprises an inward key portion provided in an inner circumference of the outer joint and engageable with the outward circumferential groove for preventing the relative movement between the pair of steel pipes in the longitudinal direction thereof.

[0019]

Since the above arrangement is a simple arrangement of engagement provided between an outward key portion and an inward circumferential groove, this can eliminate the need for incorporating a key member within an inward circumferential groove in advance as required by the conventional joint mechanism, so that the thickness of the outer joint can be reduced and the material cost can be reduced correspondingly. Moreover, as the first inner joint and the second inner joint can be provided with an identical shape, reduction of processing cost can be realized also.

[0020]

According to a seventh characterizing feature of the present invention, the first inner joint and the second inner joint respectively comprises a straight seam steel pipe, and a bonding portion included in each straight seam steel pipe is disposed at a position not overlapped with the cutout portion formed in the first inner joint or the second inner joint.

[0021]

A straight seam steel pipe is manufactured by a sheet rolling technique. The sheet rolling technique is inexpensive in comparison with other techniques such as ring forging technique employed for manufacturing a seamless steel pipe. By constituting the first inner joint and the second inner joint of a straight seam steel pipe respectively, the first inner joint and the second inner joint can be obtained inexpensively.

On the other hand, the straight seam steel pipe has the bonding portion along its longitudinal direction, so that uniformity in the circumferential direction cannot be obtained, thus suffering the disadvantage of lower rigidity at its circumferential portion, hence being less resistant against an inner pressure or a torsion.

Further, the circumferential portion of the first/second inner joint formed with the cutout portion, due to the smaller amount of forming material at this portion, has lower rigidity than the other circumferential portion.

For this reason, the cutout portion is provided in the first inner joint and the second inner joint in such a manner that the cutout portion is disposed at a position different from the position across and between the bonding portion included in the straight seam steel pipe.

Therefore, by the arrangement of avoiding overlap between the circumferential portion formed with the cutout portion and the bonding portion in the longitudinal direction of the straight seam steel pipe, it is possible to reduce the disadvantageous effect of reduced rigidity in one portion of the first inner joint and the second inner joint as compared with the other portion thereof.

[0022]

According to an eighth characterizing feature of the present invention, the outer joint comprises a straight seam steel pipe, and a bonding portion included in the straight seam steel pipe is disposed in the standard unit member.

[0023]

As described above, the straight seam steel pipe can be manufactured at much lower costs than the seamless pipe. Therefore, by constituting the outer joint of a straight seam steel pipe, the outer joint can be obtained inexpensively.

The closing unit member of the outer joint is disposed at the cutout portion of the first inner joint and the second inner joint. If the bonding portion were provided at a position overlapped with the cutout portion, this would result in reduction of rigidity at the cutout portion where the closing unit member having the bonding portion is disposed.

Therefore, the bonding portion is provided in the standard unit member.

By the arrangement of avoiding overlap between the closing unit member and the bonding portion in the longitudinal direction of the straight seam steel pipe, it is possible to reduce the disadvantageous effect of excessive reduced rigidity in one portion as compared with the other portion in the joint mechanism.

[0024]

According to a first characterizing feature of a connection method of the present invention, the connection method connecting a pair of steel pipes to each other with using the joint mechanism having any one of the first through seventh characterizing features described above, the method comprises the steps of:

placing a first inner joint provided at one end of one steel pipe and a second inner joint provided at the other end of the other steel pipe adjacent each other;

positioning a first cutout portion provided in the first inner joint and a second cutout portion provided in the second inner joint in fixed opposition to each other along a longitudinal direction of the steel pipes;

disposing an outer joint circumferentially between and across the first inner joint and the second inner joint by inserting, via the first cutout portion and the second cutout portion, a standard unit member having engaging projecting portions at an end portion thereof on the first inner joint side and an end portion thereof on the second inner joint side, respectively, the standard unit member being included in a plurality of unit members constituting the outer joint;

engaging an engaging portion provided in one of an outer circumference of the first inner joint and the second inner joint respectively and an inner circumference of the outer joint with an engaged portion provided in the other of the outer circumference and the inner circumference for preventing relative movement between the pair

of steel pipes along the longitudinal direction of these steel pipes;

sliding the engaging projecting portion in the circumferential direction of the steel pipes along an engaging sunk portion provided in the first inner joint and the second inner joint respectively, with maintaining engagement between the engaging portion and the engaged portion;

inserting a closing unit member included in the plurality of unit members constituting the outer joint and having a shape to be in flush with an outer circumferential face around the cutout portion when this closing unit member is disposed within the cutout portion through the first cutout portion and the second cutout portion, thereby to establish engagement between an outward circumferential groove and an inward key portion or between an outward key groove and an inward circumferential groove; and

fixing the closing unit member to at least the first inner joint or the second inner joint.

[0025]

According to a second characterizing feature of the method of the invention, at the step of positioning the first cutout portion provided in the first inner joint and the second cutout portion provided in the second inner joint in fixed opposition to each other along the longitudinal direction of the steel pipes, before the step of placing the first inner joint and the second inner joint adjacent each other, the closing unit member is disposed in advance within the first cutout portion or the second cutout portion, and then, the first cutout portion and the second cutout portion are placed in opposition to each other along the longitudinal direction of the steel pipes with utilizing the closing unit member and then the closing unit member is temporarily removed after the positioning.

[0026]

For positioning the first cutout portion and the second cutout portion in fixed opposition to each other along the longitudinal direction of the steel pipes, the closing unit member to be used in the subsequent step is effectively utilized, so that any separate arrangement for the positioning can be omitted.

[Brief Description of the Drawings]

[0027]

[Fig. 1] Fig. 1 is an explanatory view of a steel pipe and a joint mechanism,

5 [Fig. 2] Fig. 2 is an explanatory view of an inner joint,

[Fig. 3] Fig. 3 is a side view in section of the inner joint,

[Fig. 4] Fig. 4 is an explanatory view regarding engagement of a steel pipe pile using unit members,

10 [Fig. 5] Fig. 5 is a side view in section regarding engagement of the steel pipe pile using unit members,

[Fig. 6] Fig. 6 is an explanatory view regarding engagement of the steel pipe pile using unit members,

[Fig. 7] Fig. 7 is a side view in section regarding engagement of the steel pipe pile using unit members,

15 [Fig. 8] Fig. 8 is a plane view in section regarding engagement of the steel pipe pile using unit members,

[Fig.9] Fig.9 is an explanatory view regarding closing of cutout portions,

20 [Fig.10] Fig.10 is a side view in section regarding closing of cutout portions,

[Fig. 11] Fig. 11 is a plane view in section regarding closing of cutout portions,

[Fig. 12] Fig. 12 is a side view in section of an inner joint according to a further embodiment,

25 [Fig. 13] Fig. 13 is a side view in section of an inner joint according to a further embodiment, and

[Fig. 14] Fig. 14 is an explanatory view of a steel pipe joint mechanism according to a further embodiment.

[Embodiments]

[0028]

Next, a steel pipe joint mechanism and connection method according to the present invention will be described in details with reference to the accompanying drawings.

35 Fig. 1 shows a steel pipe pile 1, as an example of a steel pipe, which has a cylindrically shaped outer circumferential face and which is

to be driven into a ground by means of a hydraulic hammer, a jacking machine, a rotary jacking machine, etc. Fig. 1 also shows a joint mechanism for connecting a pair of steel pipe piles 1 to each other along the longitudinal direction of these steel pipe piles 1. Incidentally, although all of the steel pipe piles 1 are of an identical construction, where there arises a need for explaining one steel pipe pile 1 in distinction from the other steel pipe pile 1, reference numerals provided to respective components of one steel pipe pile 1 will be provided with an subscript A, whereas reference numerals provided to respective components of the other steel pipe pile 1 will be provided with an subscript B, respectively.

[0029]

Each steel pipe pile 1 (1A, 1B) comprises a tubular body 2 (2A, 2B) and inner joints 10 having a generally cylindrical shape, formed of cast iron and welded coaxially to opposed ends of the tubular body 2 (2A, 2B). The inner joints 10 welded to the opposed ends of the tubular body 2 (2A, 2B) are of an identical construction, yet, reference numerals provided to the respective components of the inner joint 10 which is to be disposed on the lower side when the steel pipe pile 1 is driven into the ground are provided with the subscript A, whereas reference numerals provided to the respective components of the inner joint 10 which is to be disposed on the upper side then are provided with the subscript B, respectively. That is, one of the pair of inner joints 10A, 10B constitutes “a first inner joint”, and the other thereof constitutes “a second inner joint”. As the first inner joint and the second inner joint have the identical construction, manufacturing cost reduction is made possible as compared with a case of providing them with different constructions.

[0030]

As shown in Fig. 2, the inner joint 10 includes a base portion 11 having a slightly larger outside diameter than an outside diameter of the tubular body 2 and an inner fitting portion 12 having a smaller outside diameter than the base portion 11, the inner fitting portion 12 extending continuously from the base portion 11. In the instant embodiment, the outside diameter of the base portion 11 is about 18 mm larger than the outside diameter of the tubular body 2.

In the outer circumference of the inner fitting portion 12, there is

defined a single line of outward circumferential groove 13 for engagement of an inward key portion 23 which will be described later herein. In an end face of the base portion 11 facing the inner fitting portion 12 side, there is provided, in the form of a circular ring, an engaging sunk portion 14 for engagement of an engaging projecting portion 24 provided at an end portion of an outer joint 20 to be described later (see Fig. 1).

[0031]

As shown in Fig. 1, the wall face constituting the engaging sunk portion 14 includes cutout portions 15 at four positions thereof spaced apart from each other equidistantly in the circumferential direction.

[0032]

The inner joint 10A and the inner joint 10B respectively includes a hole portion 18 formed at a predetermined position in its mutually contacting face and into this hole portion 18, a positioning pin 19 will be inserted.

As shown in Fig. 3, when the inner joint 10A and the inner joint 10B are to be connected, the positioning pins 19 will be inserted into the hole portion 18A formed in the inner joint 10A and the hole portion 18B formed in the inner joint 10B, whereby the cutout portion 15A provided in the inner joint 10A and the cutout portion 15B provided in the inner joint 10B are fixed in mutually opposing positions along the longitudinal direction of the steel pipe pile 1.

[0033]

As shown in Fig. 1, the outer joint 20 is comprised of eight unit members 21 which are formed by splitting a cylindrical body formed of cast iron and having an outside diameter slightly larger than the outside diameter of the tubular body 2 and an inside diameter allowing fitting/insertion of the inner joint 10, into eight equal parts. In the instant embodiment, the outside diameter of the outer joint 20 is about 18 mm larger than the outside diameter of the tubular body 2.

[0034]

Incidentally, the splitting into eight equal parts is only exemplary. The number of the unit members 21 obtained by splitting can be smaller than or greater than eight. But, it is preferred that the size of the unit member 21 obtained by such splitting be such a size as allows hand

lifting of this member by a worker. Alternatively, the unit members 21 could be manufactured also by bending separate iron plates one by one. However, with use of the above-described simple manufacturing method of splitting a straight seam steel pipe, manufacturing cost can be reduced as compared with the case of manufacturing them one by one.

[0035]

In the inner circumference of the outer joint 20 formed of the eight unit members 21, there are provided two parallel lines of circular and annular inward key portions 23 (23A, 23B) engageable with outward circumferential grooves 13 (13A, 13B) provided in the inner joint 10A and the inner joint 10B respectively, with the inward key portions 23 (23A, 23B) being provided at positions where these key portions can engage the outward circumferential grooves 13 (13A, 13B) when the outer joint 20 is fitted around the inner fitting portions 12 (12A, 12B) of the inner joints 10 (10A, 10B).

[0036]

Four unit members 21 out of the respective unit members 21 each includes the engaging projecting portions 24 at its upper and lower end portions thereof in the drawing. These unit members 21 respectively constitute “a standard unit member 21A”. As this standard unit member 21A is slid along the circumferential direction after engagement is established via the cutout portion 15 between the inward key portion 23 and the outward circumferential groove 13 of the inner joint 10, engagement is established between the engaging projecting portion 24 and the engaging sunk portion 14, whereby inadvertent detachment of the standard unit member 21A to the outside is prevented.

[0037]

Each one of the other remaining four unit members 21 does not have the engaging projecting portions 24, but has a shape which will be in flush with the outer circumferential face around the cutout portion 15 when it is disposed within this cutout portion 15. These unit members 21 respectively constitute “a closing unit member 21B”. The closing unit member 21 does not have the engaging projecting portions 24 engageable with the engaging sunk portion 14 of the inner joint 10, but has an opening that allows insertion of a bolt. The first inner joint 20A and the second inner joint 20B define bolt holes 16 (16A, 16B) at

positions corresponding to the above-described opening. Then, with use of bolts 33, the closing unit member 21 can be fixed to the first inner joint 20A and the second inner joint 20B.

[0038]

5 When the closing unit members 21B are fixed to the first inner joint 20A and the second inner joint 20B with using the bolts 33, relative movement in the circumferential direction between these inner joints 10A and 10B connected via the outer joint 20 is prevented also.

[0039]

10 In the instant embodiment, the standard unit members 21A and the closing unit members 21B four of which respectively are provided are disposed side by side in alternation around the inner joints 10, thus together constituting the cylindrical outer joint 20.

[0040]

15 Next, with reference to Figs. 2 through 11, there will be explained a connection method of the present invention for connecting a subsequent steel pipe pile 1B to a foregoing steel pipe pile 1 which has been driven firstly, in construction method of driving into the ground with using e.g. a hydraulic hammer.

20 [0041]

In this connection method of connecting the pair of steel pipe piles 1A, 1B, the above-described joint mechanism is employed.

25 Firstly, as shown in Fig. 1, Fig. 2 and Fig. 3, the steel pipe pile 1B will be suspended in such a manner to bring the inner joint 10B provided at its lower end into contact with the inner joint 10A provided at the upper end of the firstly driven one steel pipe pile 1A. In the course of this, the positioning pins 19 will be inserted in advance into the hole portions 18A formed in the inner joint 10A and then, a suspending operation will be carried out with using a machine such as a crane, while confirming
30 insertion of the positioning pins 19 into the hole portions 18B formed in the inner joint 10B.

[0042]

35 Next, as shown in Fig. 4 and Fig. 5, the standard unit members 21A will be disposed circumferentially so that their inward key portions 23 (23A, 23B) may come into engagement with the outward circumferential groove 13 (13A, 13b) of the inner joint 10 (10A, 10B).

[0043]

Then, as shown in Fig. 6, Fig. 7 and Fig. 8, the standard unit member 21A will be slid along the circumferential direction to a position where engagement between the engaging projecting portion 24 and the engaging sunk portion 14 is established.

[0044]

Thereafter, as shown in Fig. 9 and Fig. 10, the closing unit members 21B will be disposed circumferentially so that their inward key portions 23 (23A, 23B) may come into engagement with the outward circumferential grooves 13 (13A, 13B) of the inner joints 10 (10A, 10B) via the cutout portions 15A, 15B.

[0045]

Lastly, as shown in Fig. 10 and Fig. 11, the closing unit members 21B will be fixed to the inner joints 10 (10A, 10B) with using the bolts 33, whereby the pair of steel pipe piles 1A, 1B can be connected to each other so as not to be movable relative to each other in the longitudinal direction of the steel pipe piles 1 and not movable relative to each other in the circumferential direction also.

[0046]

In the foregoing, as the arrangement for engagement among the inner joint 10A, the inner joint 10B and the outer joint 20, there was explained the arrangement in which in the outer circumference of each one of the inner joint 10A and the inner joint 10B, the outward circumferential groove 13 is provided as the engaged portion and in the inner circumference of the outer joint, the inward key portions 23 are provided as the engaging portion. However, an alternative arrangement is possible. In this, in the outer circumference of each one of the inner joint 10A and the inner joint 10B, an outward key portion is provided as the engaging portion whereas the engaged portion is provided as an inward circumferential groove in the inner circumference of the outer joint 20, so that with engagement therebetween, relative movement between the pair of steel pipe piles 1A, 1B in the longitudinal direction of the steel pipe piles 1 in the longitudinal direction of the steel pipe piles 1.

[0047]

In the embodiment of the steel pipe joint mechanism described above, the inner joint 10A and the inner joint 10B include the hole

portions 18 in their mutually contacting faces and into these hole portions 18, the positioning pins 19 can be inserted. However, the present invention is not limited to such embodiment.

[0048]

5 As an alternative arrangement for positioning the cutout portion 15A provided in the inner joint 10A and the cutout portion 15B provided in the inner joint 10B into fixed opposition to each other in the longitudinal direction of the steel pipe piles 1, as shown in Fig 12, for instance, a projecting portion and a sunk portion engageable with each other are provided along the circumferential direction in the mutually opposing faces of the inner joint 10A and the inner joint 10B, respectively.

[0049]

15 Further alternatively, as shown in Fig. 13, for instance, the respective mutually opposing faces of the inner joint 10A and the inner joint 10B may include a small diameter portion and a large diameter portion along the circumferential direction, with a leading end of one of them being engageable with a leading end of the other.

[0050]

20 Further alternatively, though not shown, the mutually opposing faces of the inner joint 10A and the inner joint 10B may omit at all such arrangement for positioning the cutout portion 15A provided in the inner joint 10A and the cutout portion 15B provided in the inner joint 10B into fixed opposition to each other in the longitudinal direction of the steel pipe piles 1.

[0051]

30 As shown in Fig. 12 and Fig. 13, in the case of the joint mechanism having no positioning pins 19 as the arrangement for positioning the cutout portion 15A provided in the inner joint 10A and the cutout portion 15B provided in the inner joint 10B into fixed opposition to each other in the longitudinal direction of the steel pipe piles 1, though not shown in particular, in the case of absence of the arrangement for positioning the cutout portion 15A provided in the inner joint 10A and the cutout portion 15B provided in the inner joint 10B into fixed opposition to each other in the longitudinal direction of the steel pipe piles 1, an alternative connection method as follows will be

employed preferably.

[0052]

As shown in Fig. 1, Fig. 2 and Fig. 3, the steel pipe pile 1B will be suspended in such a manner to bring the inner joint 10B provided at its lower end into contact with the inner joint 10A provided at the upper end of the firstly driven one steel pipe pile 1A.

[0053]

In the course of the above, one or some of the plurality of closing unit members 21B will be fixed temporarily in advance at one or more positions of the plurality of cutout portions 15A with using the bolt(s) 33. Then, the steel pipe pile 1B will be suspended with using a machine such as a crane while confirming insertion of the closing unit members 21B into the cutout portions 15B formed in the inner joint 10B. With this, the cutout portion 15A provided in the inner joint 10A and the cutout portion 15B provided in the inner joint 10B are brought to and fixed at positions in opposition to each other in the longitudinal direction of the steel pipe piles 1.

[0054]

Incidentally, at one or more positions of the plurality of cutout portions 15B, one or more closing unit members 21B may be fixed temporarily in advance with using the bolt(s) 33 and then, the steel pipe pile 1B may be suspended with using a machine such as a crane while confirming insertion of the closing unit members 21B into the cutout portions 15A formed in the inner joint 10A.

[0055]

After the positioning step above, the closing unit members 21B which have been temporarily fixed will be removed first and then, like the foregoing explanation, as shown in Fig. 4 and Fig. 5, the standard unit members 21A will be disposed circumferentially such that their inward key portions 23 (23A, 23B) may come into engagement with the outward circumferential grooves 13 (13A, 13B) of the inner joint 10 (10A, 10b) via the cutout portions 15A, 15B.

[0056]

And, as shown in Fig. 6, Fig. 7 and Fig. 8, each standard unit member 21B will be slid along the circumferential direction to the position where the engaging projecting portion 24 and the engaging sunk

portion 14 come into engagement with each other.

[0057]

Next, as shown in Fig. 9 and Fig. 10, each closing unit member 21B will be disposed circumferentially so that its inward key portion 23 (23A, 23B) may come into engagement with the outward circumferential groove 13 (13A, 13B) of the inner joint 10 (10A, 10B) via the cutout portion 15A, 15B.

[0058]

Lastly, as shown in Fig. 10 and Fig. 11, the closing unit members 21B will be fixed to the inner joints 10 (10A, 10B) with using the bolts 33, whereby the pair of steel pipe piles 1 can be connected to each other not to be relatively movable in the longitudinal direction of the steel pipe piles 1 and not relatively movable in the circumferential direction, either.

[0059]

As described above, even in the case of the absence of the positioning pins 19, the cutout portion 15A provided in the inner joint 10A and the cutout portion 15B provided in the inner joint 10B may still be brought to and fixed at positions in opposition to each other in the longitudinal direction of the steel pipe piles 1.

[0060]

In the foregoing embodiment, respecting the inner joints 10 and the outer joint 20, the configurations thereof obtained by working a cylindrical body formed of cast iron into the respective predetermined shape were explained. However, the invention is not limited to such embodiment. For instance, as shown in Fig. 14, the inner joints and the outer joint 20 can be formed of straight steam steel pipes. Incidentally, the tubular body 2 can be formed of a spiral steel pipe.

[0061]

Such straight steam steel pipe is manufactured generally by using a sheet rolling technique comprising forming a flat-plate like steel sheet into a cylindrical shape with using a huge roll or press and welding the bonding portion 3 from the inner and outer faces thereof. The sheet rolling technique is more inexpensive than other techniques such as the ring forging technique used for manufacturing a seamless steel pipe, with much lower costs than the costs required for the latter technique. By forming the inner joints 10 and the outer joint 20 of straight seam

steel pipes, the inner joints 10 and the outer joint 20 can be obtained inexpensively.

[0062]

5 However, the straight seam steel pipe, due to the presence of the bonding portion 3 along its longitudinal direction, suffers non-uniformity in the circumferential direction unlike the seamless steel pipe, thus being unable to obtain uniform rigidity in the circumferential direction, hence being less resistant to inside pressure or torsion.

10 Further, the circumferential portions of the inner joint 10A and the inner joint 10B having the cutout portions 15A, 15B include a smaller amount of forming material, thus being lower in rigidity than the other circumferential portions thereof.

15 For this reason, the cutout portions 15A, 15B are provided in the inner joint 10A and the inner joint 10B at positions not present across the bonding portions 3 included in the straight seam steel pipes.

20 By the arrangement of avoiding overlap between the circumferential portions formed with the cutout portions 15A, 15B with the bonding portions 3 along the longitudinal direction of the straight seam steel pipes 1, it is possible to prevent the rigidity of a portion of the inner joint 10A and the inner joint 10B from being too lower than the other portion thereof.

[0063]

25 Incidentally, it is preferred that the inner joint 10A and the inner joint 10B be connected in such a manner to avoid overlap between the respective bonding portions 3 thereof along the longitudinal direction of the steel pipe piles 1.

[0064]

30 Further, the closing unit members 21B of the outer joint 20 are disposed at the cutout portions 15A, 15B of the inner joint 10A and the inner joint 10B. If the bonding portions 3 were disposed at positions overlapped with the cutout portions 15A, 15B, this would result in disadvantageous reduction in the rigidity at the cutout portions 15A, 15B wherein the closing unit members 21B having the bonding portions 3 are disposed.

35 Therefore, the bonding portion 3 is provided in the standard unit member 21A.

By the arrangement of avoiding overlap between the closing unit member 21B and the bonding portion 3 along the longitudinal direction of the straight seam steel pipe, it is possible to avoid excessive reduction in the rigidity of a certain portion of the joint mechanism as compared with the other portion thereof.

[0065]

Incidentally, preferably, the standard unit member 21A having the bonding portion 3 and included in the plurality of standard unit members 21A is disposed circumferentially at a position different from the position where the bonding portion 3 in the inner joint 10A and the inner joint 10B is disposed.

[0066]

The joint mechanism according to the present invention may be used not only for the foundation piles for structure installment, but also for steel pipes such as soil retaining steel pipe sheet piles, anti-landslide piles, pier posts, etc.

[0067]

The foregoing embodiments are only specific non-limiting examples of the present invention. The description thereof does not limit the scope of the present invention in any way. The specific arrangements of the respective parts or portions thereof can be modified in any way appropriately as long as the intended advantageous functions/effects of the present invention can be achieved.

[Description of Reference Marks/Numerals]

[0068]

- 1: steel pipe pile (steel pipe)
- 2: tubular body
- 10: inner joint
- 11: base portion
- 12: inner fitting portion
- 13: outward circumferential groove (engaged portion)
- 14: engaging sunk portion
- 15: cutout portion
- 16: bolt hole
- 18: hole portion

	19:	pin
	20:	outer joint
	21:	unit member
	21A:	standard unit member
5	21B:	closing unit member
	22:	opening portion
	23:	inward key portion (engaging portion)
	24:	engaging projecting portion
	33:	bolt
10		

CLAIMS

1. A joint mechanism for a steel pipe comprising:
 - a first inner joint provided at one end of one steel pipe;
 - 5 a second inner joint provided at the other end of the other steel pipe;
 - an outer joint disposed circumferentially between and across the first inner joint and the second inner joint for connecting a pair of the steel pipes to each other when the first inner joint of one steel pipe is placed adjacent the second inner joint of the other steel pipe;
 - 10 an engaging portion provided in one of an outer circumference of the first inner joint and the second inner joint respectively and an inner circumference of the outer joint; and
 - an engaged portion provided in the other of the outer circumference and the inner circumference to be engaged with the engaging portion for preventing relative movement between the pair of steel pipes along a longitudinal direction of these steel pipes;
 - 15 wherein the outer joint comprises a plurality of unit members disposed side by side around the first inner joint and the second inner joint;
 - the plurality of unit members include a standard unit member having engaging projecting portions at an end portion thereof on the first inner joint side and an end portion thereof on the second inner joint side, respectively;
 - 20 the first inner joint and the second inner joint respectively has an engaging sunk portion engageable with the engaging projecting portion for preventing detachment of the standard unit member to the outside; and
 - at least a portion of a wall face constituting the engaging sunk portion includes a cutout portion capable of inserting the engaging projecting portion of the standard unit member to a position corresponding to the engaging sunk portion.
 - 25
 - 30
2. The joint mechanism according to claim 1, wherein the plurality of unit members further include a closing unit member having a shape to be in flush with an outer circumferential face around the
- 35

cutout portion when this closing unit member is disposed within the cutout portion, and there is provided a fixing mechanism for fixing the closing unit member to at least the first inner joint or the second inner joint.

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3. The joint mechanism according to claim 1 or 2, wherein:

the cutout portion includes a first cutout portion provided in the first inner joint and a second cutout portion provided in the second inner joint; and

10 the first inner joint and the second inner joint respectively includes a positioning mechanism for positioning the first cutout portion and the second cutout portion in fixed opposition to each other along the longitudinal direction of the steel pipes when the first inner joint of one steel pipe is placed adjacent the second inner joint of the other steel pipe for connection of the pair of steel pipes to each other.

15

4. The joint mechanism according to claim 3, wherein the positioning mechanism comprises a hole portion provided in a mutually opposing face of the first inner joint and the second inner joint respectively and a positioning pin to be inserted into the hole portion.

20

5. The joint mechanism according to any one of claims 1-4, wherein:

25 the engaged portion comprises an outward circumferential groove provided in an outer circumference of the first inner joint and the second inner joint respectively; and

the engaging portion comprises an inward key portion provided in an inner circumference of the outer joint and engageable with the outward circumferential groove for preventing the relative movement between the pair of steel pipes in the longitudinal direction thereof.

30

6. The joint mechanism according to any one of claims 1-4, wherein:

35 the engaging portion comprises an outward key portion provided in an outer circumference of the first inner joint and the second inner joint respectively; and

the engaged portion comprises an inward key portion provided in an inner circumference of the outer joint and engageable with the outward circumferential groove for preventing the relative movement between the pair of steel pipes in the longitudinal direction thereof.

5

7. The joint mechanism according to any one of claims 1-6, wherein:

the first inner joint and the second inner joint respectively comprises a straight seam steel pipe; and

10 a bonding portion included in the straight seam steel pipe is disposed at a position not overlapped with the cutout portion formed in the first inner joint or the second inner joint.

8. The joint mechanism according to any one of claims 1-7; wherein:

15 the outer joint comprises a straight seam steel pipe; and

a bonding portion included in the straight seam steel pipe is disposed in the standard unit member.

20 9 A connection method for connecting a pair of steel pipes to each other with using the joint mechanism according to any one of claims 1-8, the method comprising the steps of:

placing a first inner joint provided at one end of one steel pipe and a second inner joint provided at the other end of the other steel pipe adjacent each other;

25 positioning a first cutout portion provided in the first inner joint and a second cutout portion provided in the second inner joint in fixed opposition to each other along a longitudinal direction of the steel pipes;

30 disposing an outer joint circumferentially between and across the first inner joint and the second inner joint by inserting, via the first cutout portion and the second cutout portion, a standard unit member having engaging projecting portions at an end portion thereof on the first inner joint side and an end portion thereof on the second inner joint side, respectively, the standard unit member being included in a plurality of unit members constituting the outer joint;

35 engaging an engaging portion provided in one of an outer

circumference of the first inner joint and the second inner joint respectively and an inner circumference of the outer joint with an engaged portion provided in the other of the outer circumference and the inner circumference for preventing relative movement between the pair of steel pipes along the longitudinal direction of these steel pipes;

sliding the engaging projecting portion in the circumferential direction of the steel pipes along an engaging sunk portion provided in the first inner joint and the second inner joint respectively, with maintaining engagement between the engaging portion and the engaged portion;

inserting a closing unit member included in the plurality of unit members constituting the outer joint and having a shape to be in flush with an outer circumferential face around the cutout portion when this closing unit member is disposed within the cutout portion through the first cutout portion and the second cutout portion, thereby to establish engagement between an outward circumferential groove and an inward key portion or between an outward key groove and an inward circumferential groove; and

fixing the closing unit member to at least the first inner joint or the second inner joint.

10. The method according to claim 9, wherein at the step of positioning the first cutout portion provided in the first inner joint and the second cutout portion provided in the second inner joint in fixed opposition to each other along the longitudinal direction of the steel pipes, before the step of placing the first inner joint and the second inner joint adjacent each other, the closing unit member is disposed in advance within the first cutout portion or the second cutout portion, and then, the first cutout portion and the second cutout portion are placed in opposition to each other along the longitudinal direction of the steel pipes with utilizing the closing unit member and then the closing unit member is temporarily removed after the positioning.