

DESCRIPTION

SCREW-TYPE STEEL PIPE PILE

Field

[0001] The present invention relates to a screw-type
5 steel pipe pile.

Background

[0002] Conventionally, as a screw-type steel pipe pile
that is buried in the ground by the screw action by being
given a turning force, as illustrated in FIGS. 10(a) and
10 11(a), one that includes a steel pipe 100 and a plurality
of (two, in the example in FIGS. 10(a) and 11(a)) steel-
made plates 200a and 200b has been known. In the screw-
type steel pipe pile illustrated in FIGS. 10 and 11, a
distal end side is described as the lower side and a pile
15 head side is described as the upper side.

[0003] The steel pipe 100 is formed in a cylindrical
shape having a hollow portion 110 in the inside. In the
distal end portion of this steel pipe 100, a plurality of
(two, in the example illustrated in FIGS. 10 and 11)
20 attaching portions 120a and 120b are formed. The attaching
portions 120a and 120b are each formed on the distal end
portion of the steel pipe 100 along the circumferential
direction. In these attaching portions 120a and 120b, the
respective distal end faces constitute tilt surfaces that
25 gradually tilt downward from one side in the
circumferential direction to the other side. The attaching
portions 120a and 120b illustrated are the ones that the
extending lengths of the distal end faces and the tilt
angles of the distal end faces are equal to each other.

30 [0004] The steel-made plates 200a and 200b are each
formed by dividing a circular steel plate the outer
diameter of which is larger than that of the steel pipe 100
into two parts, and form a semicircular shape. The steel-

made plate 200a of one side is, by being attached along the distal end face on one side, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 100. The outer circumferential portion of this steel-made plate 200a is, as illustrated in FIGS. 10(b) and 11(b), projecting outward in the radial direction of the steel pipe 100.

[0005] The steel-made plate 200b of the other side is, by being attached along the distal end face on the other side, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 100. The outer circumferential portion of this steel-made plate 200b is, as illustrated in FIGS. 10(b) and 11(b), projecting outward in the radial direction of the steel pipe 100.

[0006] Then, because the two attaching portions 120a and 120b are the ones that the extending lengths and tilt angles of the distal end faces are equal to each other as in the foregoing, the tilt angles of the steel-made plates 200a and 200b that are attached to the respective attaching portions 120a and 120b are equal to each other.

[0007] Such a screw-type steel pipe pile thus structured is buried in the ground, by the screw action with the projecting portions of the steel-made plates 200a and 200b, when a turning force about the central axis L of the steel pipe 100 is given (for example, see Patent Literature 1).

Citation List

Patent Literature

[0008] Patent Literature 1: Japanese Patent Application Laid-open No. H9-324419

Summary

Technical Problem

[0009] In the above-described screw-type steel pipe pile

disclosed in Patent Literature 1, however, because the steel-made plates 200a and 200b are each attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 100, a tilt-lower end portion 210a and a tilt-upper end portion 220a are formed on the steel-made plate 200a of one side and a tilt-lower end portion 210b and a tilt-upper end portion 220b are formed on the steel-made plate 200b of the other side. Then, when the screw-type steel pipe pile is given a turning force about the central axis L of the steel pipe 100, the tilt-lower end portion 210a is a portion to penetrate the ground first in the steel-made plate 200a of one side and the tilt-lower end portion 210b is a portion to penetrate the ground first in the steel-made plate 200b of the other side. As in the foregoing, because the tilt angles of the two steel-made plates 200a and 200b are equal to each other, the tilt-lower end portion 210a and the tilt-lower end portion 210b are the portions located at the lowermost positions in the two steel-made plates 200a and 200b, and are starting-end portions that first penetrate the ground in the two steel-made plates 200a and 200b.

[0010] In the above-described screw-type steel pipe pile, because the steel-made plates 200a and 200b are each attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 100, when the central axis L of the steel pipe 100 is placed so as to be orthogonal to a land surface, as illustrated in FIGS. 10(c) and 11(c), the projection geometry of the steel-made plates 200a and 200b with respect to the land surface is elliptical. In this case, a line segment E connecting the tilt-lower end portion 210a and the tilt-upper end portion 220a is the minor axis of the ellipse, and a line segment F connecting a central portion 230a that

is the position rotated counter-clockwise by 90° from the tilt-lower end portion 210a of the steel-made plate 200a of one side in FIGS. 10(c) and 11(c) and a central portion 230b that is the position rotated counter-clockwise by 90° from the tilt-lower end portion 210b of the steel-made plate 200b of the other side is the major axis of the ellipse.

[0011] Consequently, when such a screw-type steel pipe pile is made to penetrate the ground by being rotated about the central axis L of the steel pipe 100, the region from the tilt-lower end portion 210a of the steel-made plate 200a leading to the central portion 230a and the region from the tilt-lower end portion 210b of the steel-made plate 200b leading to the central portion 230b may come into contact with the ground, and thus the outer circumferential portions of the respective steel-made plates 200a and 200b overall may abrade away. When the abrasion loss increases as the result of such abrasion, it may lead to the reduction of the area and plate thickness of the respective steel-made plates 200a and 200b, and as a result, it may be difficult to obtain a good ground bearing capacity.

[0012] In order to resolve the above-described problem, it is also possible to adjust the shape of the steel-made plates 200a and 200b such that, when the central axis L of the steel pipe 100 is placed so as to be orthogonal to the land surface, the projection geometry of the steel-made plates 200a and 200b with respect to the land surface forms a circle. However, because the projection geometry varies easily depending on the tilt angles of the steel-made plates 200a and 200b with respect to the direction orthogonal to the axial direction of the steel pipe 100, it needs to alter the shape of the steel-made plates 200a and

200b appropriately depending on each tilt angle attached, and thus the manufacturing of the screw-type steel pipe pile becomes cumbersome and is not practical.

[0013] In FIGS. 10 and 11, the example that the
5 extending lengths and tilt angles of the distal end faces of the two attaching portions 120a and 120b are equal to each other has been illustrated. However, even when the tilt angles of these attaching portions 120a and 120b are different from each other, that is, even when the tilt
10 angles of the steel-made plates 200a and 200b, which are attached to the respective attaching portions 120a and 120b, are different from each other, the same problem can naturally arise.

[0014] In view of the above-described situation, an
15 object of the present invention is to provide a screw-type steel pipe pile that is capable of reducing the abrasion loss of the steel-made plates and obtaining a good ground bearing capacity.

Solution to Problem

20 [0015] To solve the problem and achieve the object, a screw-type steel pipe pile according to the present invention that is structured by attaching a plurality of steel-made plates, which are formed by dividing a circular steel plate having an outer diameter larger than that of a
25 cylindrical steel pipe into substantially fan-like shapes, along a circumferential direction of the steel pipe at an angle with respect to a direction orthogonal to an axial direction of the steel pipe, and has an opening in a central region of the steel-made plates. The screw-type
30 steel pipe pile includes: a sacrifice member configured to project outward in a radial direction from a most-distal end of the steel-made plates.

[0016] Moreover, the screw-type steel pipe pile

according to the present invention further includes a plurality of attaching portions that are formed at distal end portions of the steel pipe along a circumferential direction, and formed with respective distal end faces being made to gradually tilt toward a distal end side from one side in the circumferential direction to the other side, wherein the steel-made plates are attached along the respective distal end faces of the attaching portions.

[0017] Moreover, in the screw-type steel pipe pile according to the present invention, a ratio of a length of the sacrifice member projecting outward in the radial direction with respect to the outer diameter of the circular steel plate is 0.05 or less.

Advantageous Effects of Invention

[0018] According to the present invention, because the sacrifice member is arranged at a location on the most-distal end of the steel-made plates, and is in the form projecting outward in the radial direction than the steel-made plates having the location, the sacrifice member comes into contact with the ground and abrades away, and the rate of abrading the outer circumferential portion of the steel-made plates can thereby be reduced. As a result, when the screw-type steel pipe pile is buried in the ground, the abrasion loss of the steel-made plates is reduced and the steel-made plates have a sufficient area and a plate thickness, and thus a large ground bearing capacity as a supporting member can be obtained. Consequently, the invention has an effect in that it can reduce the abrasion loss of the steel-made plates and obtain a good ground bearing capacity.

Brief Description of Drawings

[0019] FIG. 1(a) is a front view of a relevant portion of a screw-type steel pipe pile that is a first embodiment

of the present invention.

FIG. 1(b) is a plan view of the screw-type steel pipe pile illustrated in FIG. 1(a).

FIG. 1(c) is an explanatory diagram illustrating a
5 projection geometry of the screw-type steel pipe pile illustrated in FIGS. 1(a) and 1(b) when the screw-type steel pipe pile is placed such that the central axis of the steel pipe is orthogonal to a land surface.

FIG. 2(a) is a right-hand side view of a relevant
10 portion of the screw-type steel pipe pile that is the first embodiment of the present invention.

FIG. 2(b) is a plan view of the screw-type steel pipe pile illustrated in FIG. 2(a).

FIG. 2(c) is an explanatory diagram illustrating a
15 projection geometry of the screw-type steel pipe pile illustrated in FIGS. 2(a) and 2(b) when the screw-type steel pipe pile is placed such that the central axis of the steel pipe is orthogonal to the land surface.

FIG. 3 is a perspective view illustrating a distal end
20 portion of the steel pipe illustrated in FIGS. 1 and 2.

FIG. 4 is explanatory diagram schematically illustrating a construction example of the screw-type steel pipe pile illustrated in FIGS. 1 and 2.

FIG. 5(a) is a front view of a relevant portion of a
25 screw-type steel pipe pile that is a second embodiment of the present invention.

FIG. 5(b) is a plan view of the screw-type steel pipe pile illustrated in FIG. 5(a).

FIG. 5(c) is an explanatory diagram illustrating a
30 projection geometry of the screw-type steel pipe pile illustrated in FIGS. 5(a) and 5(b) when the screw-type steel pipe pile is placed such that the central axis of the steel pipe is orthogonal to the land surface.

FIG. 6(a) is a front view of a relevant portion of a screw-type steel pipe pile that is a third embodiment of the present invention.

FIG. 6(b) is a plan view of the screw-type steel pipe
5 pile illustrated in FIG. 6(a).

FIG. 7(a) is a front view of a relevant portion of a screw-type steel pipe pile that is a fourth embodiment of the present invention.

FIG. 7(b) is a plan view of the screw-type steel pipe
10 pile illustrated in FIG. 7(a).

FIG. 8 is an enlarged side view illustrating in an enlarged manner a relevant portion of a screw-type steel pipe pile in a modification of the first embodiment of the present invention.

FIG. 9 is an enlarged side view illustrating in an enlarged manner a relevant portion of a screw-type steel pipe pile in another modification of the first embodiment of the present invention.

FIG. 10(a) is a front view of a relevant portion of a
20 conventional screw-type steel pipe pile.

FIG. 10(b) is a plan view of the screw-type steel pipe pile illustrated in FIG. 10(a).

FIG. 10(c) is an explanatory diagram illustrating a projection geometry of the screw-type steel pipe pile
25 illustrated in FIGS. 10(a) and 10(b) when the screw-type steel pipe pile is placed such that the central axis of the steel pipe is orthogonal to the land surface.

FIG. 11(a) is a right-hand side view of a relevant portion of the conventional screw-type steel pipe pile.

FIG. 11(b) is a plan view of the screw-type steel pipe
30 pile illustrated in FIG. 11(a).

FIG. 11(c) is an explanatory diagram illustrating a projection geometry of the screw-type steel pipe pile

illustrated in FIGS. 11(a) and 11(b) when the screw-type steel pipe pile is placed such that the central axis of the steel pipe is orthogonal to the land surface.

Description of Embodiments

5 [0020] With reference to the accompanying drawings, the following describes in detail exemplary preferred embodiments of a screw-type steel pipe pile according to the present invention.

[0021] First Embodiment

10 FIGS. 1 and 2 are diagrams illustrating one example of a screw-type steel pipe pile that is a first embodiment of the present invention. FIG. 1(a) is a front view of a relevant portion of the screw-type steel pipe pile, and FIG. 1(b) is a plan view of the screw-type steel pipe pile
15 illustrated in FIG. 1(a). FIG. 2(a) is a right-hand side view of a relevant portion of the screw-type steel pipe pile, and FIG. 2(b) is a plan view of the screw-type steel pipe pile illustrated in FIG. 2(a). The screw-type steel pipe pile illustrated includes a steel pipe 10 and a
20 plurality of (two, in the example illustrated in FIGS. 1 and 2) steel-made plates 20a and 20b. In the screw-type steel pipe pile illustrated in FIGS. 1 and 2, a distal end side is described as the lower side and a pile head side is described as the upper side.

25 [0022] The steel pipe 10 is formed in a cylindrical shape having a hollow portion 11 in the inside. In the distal end portion of this steel pipe 10, as illustrated in FIG. 3, a plurality of (two, in the example illustrated in FIG. 3) attaching portions 12a and 12b are formed. In FIG.
30 3, to make the attaching portions 12a and 12b easier to illustrate, they are illustrated such that the distal end side is the upper side and the pile head side is the lower side.

[0023] These attaching portions 12a and 12b are, by dividing the distal end portion of the steel pipe 10 into two equal parts in the circumferential direction, formed along the circumferential direction of the distal end portion. In more detail, the attaching portion 12a is contiguous to the other attaching portion 12b via step portions 13a and 13b, and each of distal end faces 12a1 and 12b1 tilts upward gradually from one side in the circumferential direction to the other side. That is, the distal end face 12a1 of the attaching portion 12a on one side is formed at an angle so as to continue from the lower end of the step portion 13a on one side to the upper end of the step portion 13b on the other side, and the distal end face 12b1 of the attaching portion 12b on the other side is formed at an angle so as to continue from the lower end of the step portion 13b on the other side to the upper end of the step portion 13a on the one side.

[0024] The heights h of the step portions 13a and 13b are determined appropriately depending on the condition of the ground G (see FIG. 4) in which the screw-type steel pipe pile is buried, the outer diameter (hereinafter also referred to as pile diameter) of the steel pipe 10, the number of steel-made plates 20a and 20b, and others. However, it is preferable that the ratio to the pile diameter be approximately 0.1 to 0.5.

[0025] The two attaching portions 12a and 12b illustrated are the ones that the extending lengths of the distal end faces 12a1 and 12b1 and the tilt angles of the distal end faces 12a1 and 12b1 are equal to each other.

[0026] The steel-made plates 20a and 20b are each formed by dividing an annular steel plate of the outer diameter of which is larger than that of the steel pipe 10 into two parts, and form a substantially semicircular shape. The

outer diameter (hereinafter also referred to as blade diameter) of the annular steel plate is determined appropriately depending on the condition of the ground G in which the screw-type steel pipe pile is buried, the outer diameter of the steel pipe 10, the number of steel-made plates 20a and 20b, and others. The material used for the annular steel plate is the ones having the strength equivalent to those of SM490 material and SM570 material, and its thickness (plate thickness) is made to be approximately 10 to 100 mm.

[0027] The steel-made plate 20a of one side is, by being attached along the distal end face 12a1 of the attaching portion 12a on one side by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 10. The outer circumferential portion of this steel-made plate 20a is, as also illustrated in FIGS. 1(b) and 2(b), projecting outward in the radial direction of the steel pipe 10. In this steel-made plate 20a, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 10, a tilt-lower end portion 21a and a tilt-upper end portion 22a are formed.

[0028] The steel-made plate 20b of the other side is, by being attached along the distal end face 12b1 of the attaching portion 12b on the other side by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 10. The outer circumferential portion of this steel-made plate 20b is, as also illustrated in FIGS. 1(b) and 2(b), projecting outward in the radial direction of the steel pipe 10. In this steel-made plate 20b, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 10, a tilt-lower end

portion 21b and a tilt-upper end portion 22b are formed.

[0029] Then, because the two attaching portions 12a and 12b are the ones that the extending lengths and tilt angles of the distal end faces 12a1 and 12b1 are equal to each

5 other as in the foregoing, the tilt angles of the steel-made plates 20a and 20b that are attached to the respective attaching portions 12a and 12b are equal to each other.

Consequently, the tilt-lower end portion 21a and the tilt-lower end portion 21b are the portions that are located at

10 the lowermost positions in the two steel-made plates 20a and 20b, and the tilt-upper end portion 22a and the tilt-upper end portion 22b are the portions that are located at the uppermost positions in the two steel-made plates 20a and 20b.

15 [0030] In such a screw-type steel pipe pile, the ratio of the blade diameter to the pile diameter is made to be 1.5 to 3, for example.

[0031] Because the steel-made plates 20a and 20b are structured by dividing an annular steel plate, as

20 illustrated in FIGS. 1(b) and 2(b), the above-described screw-type steel pipe pile has an open-end structure in which a substantially circular opening 23 is formed in the central region of the steel-made plates 20a and 20b near the distal end of the steel pipe 10.

25 [0032] Meanwhile, because the foregoing step portions 13a and 13b are formed, portions that are open on the lateral side are formed at the distal end of the steel pipe 10. However, such portions may be closed with closure members not depicted and may not be closed. While the
30 strength of the screw-type steel pipe pile can be improved when such portions are closed with the closure members, they make taking in the gravel inside the steel pipe 10 easier when such portions are not closed.

[0033] In the above-described screw-type steel pipe pile, because the steel-made plates 20a and 20b are each attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 10, when the central axis
5 L of the steel pipe 10 is placed so as to be orthogonal to the land surface, as illustrated in FIGS. 1(c) and 2(c), the projection geometry of the steel-made plates 20a and 20b with respect to the land surface is substantially elliptical. In this case, a line segment A connecting the
10 tilt-lower end portions 21a and 21b and the tilt-upper end portions 22a and 22b is the minor axis of the ellipse, and a line segment B connecting a central portion 24a that is the position rotated counter-clockwise by 90° from the
tilt-lower end portion 21a of the steel-made plate 20a of
15 one side in FIGS. 1(c) and 2(c) and a central portion 24b that is the position rotated counter-clockwise by 90° from the tilt-lower end portion 21b of the steel-made plate 20b of the other side is the major axis of the ellipse.

[0034] In the above-described steel-made plates 20a and
20 20b, on the lower surfaces of the tilt-lower end portions 21a and 21b that are located at the lowermost positions, sacrifice members 25 are each attached by such as welding. These sacrifice members 25 are structured with excavating blades and the like, for example, and are formed in a
25 rectangular shape as illustrated in FIG. 1 when viewed from the top or from the front, and are of a rectangular parallelepiped that is formed in a parallelogram as illustrated in FIG. 2 when viewed from the right-hand side. The material for these sacrifice members 25 is not
30 specifically limited, and the strength thereof is selected appropriately according to the strength of the ground that is a subject of excavation.

[0035] These sacrifice members 25 are, in the respective

tilt-lower end portions 21a and 21b, attached so as to project outward in the radial direction than the steel-made plates 20a and 20b including the tilt-lower end portions 21a and 21b. As for the projecting lengths (overhanging
 5 lengths) of the sacrifice members 25 from the steel-made plates 20a and 20b, it is preferable that the ratios of the lengths of the sacrifice members 25 projecting outward in the radial direction with respect to the blade diameter be 0.05 or less. By the ratios of the lengths of the
 10 sacrifice members 25 projecting outward in the radial direction with respect to the blade diameter being in such a range, the loci of the sacrifice members 25 by the screw-type steel pipe pile rotating about the central axis of the steel pipe 10 can be made closer to the locus of the
 15 central portion 24a that forms the major axis.

[0036] Illustrating an example of concrete measurements, when the outer diameter of the steel pipe 10 is 1000 mm, the tilt of the steel-made plates 20a and 20b is 14.4° , and the major axis of the projection geometry (ellipse) is 2000
 20 mm and the minor axis is 1937 mm, it is desirable that the lengths of the sacrifice members 25 projecting outward in the radial direction be adjusted to be 31.5 mm.

[0037] A construction example using the screw-type steel pipe pile having the above-described structure will be
 25 described with reference to FIG. 4. As illustrated in FIG. 4(a), the screw-type steel pipe pile is made to rotate about the central axis L of the steel pipe 10 by being given a turning force, and is brought into contact with a land surface g. In this case, the tilt-lower end portion
 30 21a is a portion to penetrate the ground G first in the steel-made plate 20a of one side and the tilt-lower end portion 21b is a portion to penetrate the ground G first in the steel-made plate 20b of the other side. Moreover,

these two tilt-lower end portions 21a and 21b are the portions located at the lowermost positions in the two steel-made plates 20a and 20b, and thus are starting-end portions that first penetrate the ground G in the two
5 steel-made plates 20a and 20b.

[0038] Next, as illustrated in FIG. 4(b), by the screw action of the projecting portions of the two steel-made plates 20a and 20b, the screw-type steel pipe pile screws into the ground G. In this case, the loci of the sacrifice
10 members 25 rotated about the central axis L of the steel pipe 10 agree substantially with the loci of the central portions 24a and 24b. Even when the sacrifice members 25 make contact with the ground G and abrade away, the sacrifice members 25 reduce the rate of abrading the outer
15 circumferential portions of the steel-made plates 20a and 20b, thereby reducing the abrasion loss of the steel-made plates 20a and 20b.

[0039] As a result, as illustrated in FIG. 4(c), when the screw-type steel pipe pile is buried in the ground G, the abrasion loss of the steel-made plates 20a and 20b is
20 reduced and the steel-made plates 20a and 20b have a sufficient area and a plate thickness, and thus a large ground bearing capacity as a supporting member can be obtained.

[0040] Consequently, the screw-type steel pipe pile that is the first embodiment of the present invention reduces the abrasion loss of the steel-made plates 20a and 20b, and is capable of obtaining a good ground bearing capacity. Furthermore, because the opening 23 is formed in the
25 central region of the steel-made plates 20a and 20b, taking in the gravel and the like can be promoted through the opening 23.
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[0041] With the above-described screw-type steel pipe

pile, the sacrifice members 25 are attached to the tilt-lower end portions 21a and 21b that are the lowermost positions (distal ends) of the two steel-made plates 20a and 20b so as to project outward in the radial direction of the steel-made plates 20a and 20b. Consequently, as is performed on a hard ground G, even when the construction is performed such that, after the pile is screwed into the ground G by rotating it in a normal direction about the central axis L of the steel pipe 10, it is pulled up once by rotating it in the reverse direction and is screwed again into the ground G by rotating it in the normal direction, the construction that suppresses gaps to be formed between the ground G and the tilt-lower end portions 21a and 21b of the steel-made plates 20a and 20b and that is excellent in straightness and in stability can be performed.

[0042] Moreover, with the above-described screw-type steel pipe pile, because the sacrifice members 25 are only arranged on the tilt-lower end portions 21a and 21b, as compared with when the shape of the steel-made plates is adjusted such that the projection geometry of the steel-made plates becomes circular, the manufacturing of the screw-type steel pipe pile can be made easier.

[0043] Second Embodiment

FIG. 5 illustrates one example of a screw-type steel pipe pile that is a second embodiment of the present invention. FIG. 5(a) is a front view of a relevant portion of the screw-type steel pipe pile, and FIG. 5(b) is a plan view of the screw-type steel pipe pile. In the screw-type steel pipe pile illustrated in FIG. 5, a distal end side is described as the lower side and a pile head side is described as the upper side.

[0044] The screw-type steel pipe pile illustrated

includes a steel pipe 30 and a plurality of (two, in the example illustrated in FIG. 5) steel-made plates 40a and 40b.

[0045] The steel pipe 30 is formed in a cylindrical shape having a hollow portion 31 in the inside. In the distal end portion of this steel pipe 30, a plurality of (two, in the examples illustrated in FIG. 5) attaching portions 32a and 32b are formed. These attaching portions 32a and 32b are, by dividing the distal end portion of the steel pipe 30 into two equal parts in the circumferential direction, formed along the circumferential direction of the distal end portion.

[0046] In more detail, the attaching portion 32a is formed in the form that a distal end face 32a1 tilts upward gradually from one end portion of one side in the circumferential direction to the other end portion of the other side in the circumferential direction. The attaching portion 32b is formed in the form that a distal end face not depicted tilts upward gradually from one end portion of one side in the circumferential direction to the other end portion of the other side in the circumferential direction. In these attaching portion 32a and the attaching portion 32b, the other end portion of the attaching portion 32a and one end portion of the attaching portion 32b are continuous and one end portion of the attaching portion 32a and the other end portion of the attaching portion 32b are continuous via a step portion 33a. That is, the attaching portion 32a and the attaching portion 32b are in one piece in appearance, and the distal end face 32a1 of the attaching portion 32a is formed at an angle so as to continue from the lower end of the step portion 33a to the one end portion of the attaching portion 32b and the distal end face of the attaching portion 32b is formed at an angle

so as to continue from the other end portion of the attaching portion 32a to the upper end of the step portion 33a. In the second embodiment, the tilt angle of the distal end face 32a1 of the attaching portion 32a and the tilt angle of the distal end face of the attaching portion 32b are substantially equal. In the present invention, however, the tilt angles may be different.

[0047] The steel-made plates 40a and 40b are each formed by dividing an annular steel plate the outer diameter of which is larger than that of the steel pipe 30, and the steel-made plate 40a of one side forms a fan-like shape and the steel-made plate 40b of the other side forms a substantially semicircular shape. The outer diameter (hereinafter also referred to as blade diameter) of the annular steel plate is determined appropriately depending on the condition of the ground in which the screw-type steel pipe pile is buried, the outer diameter of the steel pipe 30 (hereinafter also referred to as pile diameter), the number of steel-made plates 40a and 40b, and others.

The material used for the annular steel plate is the ones having the strength equivalent to those of SM490 material and SM570 material, and its thickness (plate thickness) is made to be approximately 10 to 100 mm.

[0048] The steel-made plate 40a is, by being attached along the distal end face 32a1 of the attaching portion 32a on one side by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 30. The outer circumferential portion of this steel-made plate 40a is, as also illustrated in FIG. 5(b), projecting outward in the radial direction of the steel pipe 30. In this steel-made plate 40a, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 30, a

tilt-lower end portion 41a and a tilt-upper end portion 42a are formed.

[0049] The steel-made plate 40b is, by being attached along the distal end face of the attaching portion 32b on the other side by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 30. The outer circumferential portion of this steel-made plate 40b is, as also illustrated in FIG. 5(b), projecting outward in the radial direction of the steel pipe 30. In this steel-made plate 40b, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 30, a tilt-lower end portion 41b and a tilt-upper end portion 42b are formed.

[0050] As in the foregoing, because the other end portion of the attaching portion 32a and the one end portion of the attaching portion 32b are continuous and the one end portion of the attaching portion 32a and the other end portion of the attaching portion 32b are continuous via the step portion 33a, below a part of the outer circumferential portion of the steel pipe 30, that is, at a portion where the other end portion of the attaching portion 32a and the one end portion of the attaching portion 32b are continuous, the two steel-made plates 40a and 40b are arranged intersecting with each other. As just described, because the two steel-made plates 40a and 40b intersect with each other below a part of the outer circumferential portion of the steel pipe 30, a separation distance to the tilt-lower end portion 41a from this intersection is longer than the separation distance to the tilt-lower end portion 41b from the intersection. Thus, the tilt-lower end portion 41a of the steel-made plate 40a is located downward than the tilt-lower end portion 41b,

and the tilt-lower end portion 41a of the steel-made plate 40a becomes the portion located at the lowermost position in the two steel-made plates 40a and 40b.

[0051] In such a screw-type steel pipe pile, the ratio
5 of the blade diameter to the pile diameter is made to be 1.5 to 3, for example.

[0052] Because the steel-made plates 40a and 40b are structured by dividing an annular steel plate, as illustrated in FIG. 5(b), the above-described screw-type
10 steel pipe pile has an open-end structure in which a substantially circular opening 43 is formed in the central region of the steel-made plates 40a and 40b near the distal end of the steel pipe 30.

[0053] Meanwhile, because the above-described step
15 portion 33a is formed, a portion that is open on the lateral side is formed at the distal end portion of the steel pipe 30. However, such a portion may be closed with a closure member not depicted and may not be closed. While the strength of the screw-type steel pipe pile can be
20 improved when such a portion is closed with the closure member, it makes taking in the gravel inside the steel pipe 30 easier when such a portion is not closed.

[0054] In the above-described screw-type steel pipe pile, because the steel-made plates 40a and 40b are each attached
25 at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 30, when the central axis L of the steel pipe 30 is placed so as to be orthogonal to the land surface, as illustrated in FIG. 5(c), the projection geometry of the steel-made plates 40a and 40b
30 with respect to the land surface is formed. In such a projection geometry, a line segment C running through the tilt-lower end portions 41a of the steel-made plate 40a of one side and the central axis L of the steel pipe 30 is the

shortest diameter (hereinafter also referred to as minor axis), and a line segment D connecting a central portion 44a that is the position rotated clockwise by 90° from the tilt-upper end portion 42a of the steel-made plate 40a of one side in FIG. 5(c) and a central portion 44b that is the position rotated counter-clockwise by 90° from the tilt-lower end portion 41b of the steel-made plate 40b of the other side is the longest diameter (also referred to as major axis).

10 [0055] In the above-described steel-made plates 40a and 40b, on the lower surface of the tilt-lower end portion 41a that is located at the lowermost position, a sacrifice member 45 is attached by such as welding. The sacrifice member 45 is structured with an excavating blade and the like, for example. The material for the sacrifice member 15 45 is not specifically limited, and the strength thereof is selected appropriately according to the strength of the ground that is a subject of excavation.

[0056] The sacrifice member 45 is, in the tilt-lower end 20 portion 41a, attached so as to project outward in the radial direction than the steel-made plate 40a including the tilt-lower end portion 41a. As for the projecting length (overhanging length) of the sacrifice member 45 from the steel-made plate 40a, it is preferable that the ratio 25 of the length of the sacrifice member 45 projecting outward in the radial direction with respect to the blade diameter be 0.05 or less. By the ratio of the length of the sacrifice member 45 projecting outward in the radial direction with respect to the blade diameter being in such 30 a range, the locus of the sacrifice member 45 by the screw-type steel pipe pile rotating about the central axis L of the steel pipe 30 can be made closer to the loci of the central portions 44a and 44b that form the above-described

major axis.

[0057] When the screw-type steel pipe pile having the above-described structure is given a turning force to rotate about the central axis L of the steel pipe 30 and brought into contact with the land surface, the tilt-lower end portion 41a is the portion to penetrate the ground first in the steel-made plate 40a of one side and the tilt-lower end portion 41b is the portion to penetrate the ground first in the steel-made plate 40b of the other side. However, because the tilt-lower end portion 41a of the steel-made plate 40a of the one side is the portion that is located at the lowermost position in the two steel-made plates 40a and 40b, the tilt-lower end portion 41a is the starting-end portion that penetrate the ground first.

[0058] When the screw-type steel pipe pile is screwed into the ground by the screw action of the projecting portions of the two steel-made plates 40a and 40b, the locus of the sacrifice member 45, by being rotated about the central axis L of the steel pipe 30, agrees substantially with the loci of the central portions 44a and 44b. The sacrifice member 45, by making contact with the ground and abrading away, reduces the rate of abrading the outer circumferential portions of the steel-made plates 40a and 40b, thereby reducing the abrasion loss of the steel-made plates 40a and 40b.

[0059] As a result, when the screw-type steel pipe pile is buried in the ground, the abrasion loss of the steel-made plates 40a and 40b is reduced and the steel-made plates 40a and 40b have a sufficient area and a plate thickness, and thus a large ground bearing capacity as a supporting member can be obtained.

[0060] Consequently, the screw-type steel pipe pile that is the second embodiment of the present invention reduces

the abrasion loss of the steel-made plates 40a and 40b, and is capable of obtaining a good ground bearing capacity.

Furthermore, because the opening 43 is formed in the central region of the steel-made plates 40a and 40b, taking
5 in the gravel and the like can be promoted through the opening 43.

[0061] With the above-described screw-type steel pipe pile, the sacrifice member 45 is attached to the tilt-lower end portion 41a that is the lowermost position (distal end)
10 of the two steel-made plates 40a and 40b so as to project outward in the radial direction of the steel-made plate 40a. Consequently, as is performed on a hard ground, even when the construction is performed such that, after the pile is screwed into the ground by rotating it in a normal
15 direction about the central axis L of the steel pipe 30, it is pulled up once by rotating it in the reverse direction and is screwed again into the ground by rotating it in the normal direction, the construction that suppresses a gap to be formed between the ground and the tilt-lower end portion
20 41a of the steel-made plate 40a and that is excellent in straightness and in stability can be performed.

[0062] Moreover, with the above-described screw-type steel pipe pile, because the sacrifice member 45 is only arranged on the tilt-lower end portion 41a, as compared
25 with when the shape of the steel-made plates is adjusted such that the projection geometry of the steel-made plates becomes circular, the manufacturing of the screw-type steel pipe pile can be made easier.

[0063] In the above-described first embodiment and the
30 second embodiment, the screw-type steel pipe pile including the two steel-made plates 20a and 20b, and 40a and 40b have been exemplified. In the screw-type steel pipe pile in the present invention, however, the number of steel-made plates

is not limited to two, and it may be a screw-type steel pipe pile including three steel-made plates and a screw-type steel pipe pile including four steel-made plates, which are described in the following embodiments.

5 [0064] Third Embodiment

FIG. 6 illustrates one example of a screw-type steel pipe pile that is a third embodiment of the present invention. FIG. 6(a) is a front view of a relevant portion of the screw-type steel pipe pile, and FIG. 6(b) is a plan
10 view of the screw-type steel pipe pile. The screw-type steel pipe pile illustrated includes a steel pipe 50 and three steel-made plates 60a, 60b, and 60c. In the screw-type steel pipe pile illustrated in FIG. 6, a distal end side is described as the lower side and a pile head side is
15 described as the upper side.

[0065] The steel pipe 50 is formed in a cylindrical shape having a hollow portion 51 in the inside. In the distal end portion of this steel pipe 50, three attaching portions 52a, 52b, and 52c are formed.

20 [0066] These attaching portions 52a, 52b, and 52c are, by dividing the distal end portion of the steel pipe 50 into three equal parts in the circumferential direction, formed along the circumferential direction of the distal end portion. In more detail, the attaching portions 52a,
25 52b, and 52c are contiguous to one another via step portions 53, and the respective distal end faces tilt upward gradually from one side in the circumferential direction to the other side. The heights of the step portions 53 are equal to one another. The three attaching
30 portions 52a, 52b, and 52c illustrated are the ones that the extending lengths of the distal end faces and the tilt angles of the distal end faces are equal to one another.

[0067] The steel-made plates 60a, 60b, and 60c are each

formed by dividing an annular steel plate the outer diameter of which is larger than that of the steel pipe 50 into three parts, and form a fan-like shape. The outer diameter (hereinafter also referred to as blade diameter) of the annular steel plate is determined appropriately depending on the condition of the ground in which the screw-type steel pipe pile is buried, the outer diameter of the steel pipe 50 (hereinafter also referred to as pile diameter), the number of steel-made plates 60a, 60b, and 60c, and others. The material used for the annular steel plate is the ones having the strength equivalent to those of SM490 material and SM570 material, and its thickness (plate thickness) is made to be approximately 10 to 100 mm.

[0068] The first steel-made plate 60a is, by being attached along the distal end face of the first attaching portion 52a by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 50. The outer circumferential portion of this first steel-made plate 60a is, as also illustrated in FIG. 6(b), projecting outward in the radial direction of the steel pipe 50. In this first steel-made plate 60a, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 50, a tilt-lower end portion 61a and a tilt-upper end portion 62a are formed.

[0069] The second steel-made plate 60b is, by being attached along the distal end face of the second attaching portion 52b by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 50. The outer circumferential portion of this second steel-made plate 60b is, as also illustrated in FIG. 6(b), projecting outward in the radial direction of the steel pipe 50. In this second steel-made plate 60b, by

being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 50, a tilt-lower end portion 61b and a tilt-upper end portion 62b are formed.

5 [0070] The third steel-made plate 60c is, by being attached along the distal end face of the third attaching portion 52c by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 50. The outer circumferential portion of
10 this third steel-made plate 60c is, as also illustrated in FIG. 6(b), projecting outward in the radial direction of the steel pipe 50. In this third steel-made plate 60c, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 50, a
15 tilt-lower end portion 61c and a tilt-upper end portion 62c are formed.

[0071] Then, because the three attaching portions 52a, 52b, and 52c are the ones that the extending lengths and tilt angles of the distal end faces are equal to one
20 another as in the foregoing, the tilt angles of the steel-made plates 60a, 60b, and 60c that are attached to the respective attaching portions 52a, 52b, and 52c are equal to one another. Consequently, the tilt-lower end portions 61a, 61b, and 61c are the portions located at the lowermost
25 positions in the three steel-made plates 60a, 60b, and 60c.

[0072] In such a screw-type steel pipe pile, the ratio of the blade diameter to the pile diameter is made to be 1.5 to 3, for example.

[0073] Because the steel-made plates 60a, 60b, and 60c
30 are structured by dividing an annular steel plate, as illustrated in FIG. 6(b), the above-described screw-type steel pipe pile has an open-end structure in which a substantially circular opening 63 is formed in the central

region of the steel-made plates 60a, 60b, and 60c near the distal end of the steel pipe 50.

[0074] Meanwhile, because the foregoing step portions 53 are formed, portions that are open on the lateral side are formed at the distal end of the steel pipe 50. However, such portions may be closed with closure members not depicted and may not be closed. While the strength of the screw-type steel pipe pile can be improved when such portions are closed with the closure members, they make taking in the gravel inside the steel pipe 50 easier when such portions are not closed.

[0075] Note that, as illustrated in FIG. 6(b), between the steel-made plates 60a, 60b, and 60c contiguous to one another, gaps are slightly formed. As for such gaps, they may be left as they are or, for example, by making the sum total of the interior angles of the steel-made plates 60a and others exceed 360° , the gaps may be made not to appear when viewed from the upper side (pile head side) or from the lower side (distal end side).

[0076] In the above-described steel-made plates 60a, 60b, and 60c, on the lower surfaces of the tilt-lower end portions 61a, 61b, and 61c that are located at the lowermost positions, sacrifice members 65 are each attached by such as welding. These sacrifice members 65 are structured with an excavating blade and the like, for example. The material for these sacrifice members 65 is not specifically limited, and the strength thereof is selected appropriately according to the strength of the ground that is a subject of excavation.

[0077] These sacrifice members 65 are, in the respective tilt-lower end portions 61a, 61b, and 61c, attached so as to project outward in the radial direction than the steel-made plates 60a, 60b, and 60c including the tilt-lower end

portions 61a, 61b, and 61c. As for the projecting lengths (overhanging lengths) of the sacrifice members 65 from the steel-made plates 60a, 60b, and 60c, it is preferable that the ratios of the lengths of the sacrifice members 65

5 projecting outward in the radial direction with respect to the blade diameter be 0.05 or less.

[0078] In the above-described screw-type steel pipe pile, the steel-made plates 60a, 60b, and 60c are each attached at an angle with respect to the direction orthogonal to the
10 axial direction of the steel pipe 50. Thus, in the projection geometry that is formed on the land surface when the central axis LL of the steel pipe 50 is placed so as to be orthogonal to the land surface, the line segment running through the central axis L of the steel pipe 50 and each of
15 the tilt-lower end portions 61a, 61b, and 61c of the respective steel-made plates 60a, 60b, and 60c is the shortest diameter.

[0079] When the screw-type steel pipe pile having the above-described structure is given a turning force to
20 rotate about the central axis L of the steel pipe 50 and brought into contact with the land surface, the tilt-lower end portion 61a is the portion to penetrate the ground first in the first steel-made plate 60a, the tilt-lower end portion 61b is the portion to penetrate the ground first in
25 the second steel-made plate 60b, and the tilt-lower end portion 61c is the portion to penetrate the ground first in the third steel-made plate 60c. Moreover, these three tilt-lower end portions 61a, 61b, and 61c are the portions located at the lowermost positions in the three steel-made
30 plates 60a, 60b, and 60c, and thus are starting-end portions that first penetrate the ground in the three steel-made plates 60a, 60b, and 60c.

[0080] Then, when the screw-type steel pipe pile is

screwed into the ground by the screw action of the projecting portions of the three steel-made plates 60a, 60b, and 60c, the sacrifice members 65, by being rotated about the central axis L of the steel pipe 50, make contact with the ground and abrade away, thereby reducing the rate of abrading the outer circumferential portions of the steel-made plates 60a, 60b, and 60c. Thus, the abrasion loss of the steel-made plates 60a, 60b, and 60c is reduced.

[0081] As a result, when the screw-type steel pipe pile is buried in the ground, the abrasion loss of the steel-made plates 60a, 60b, and 60c is reduced and the steel-made plates 60a, 60b, and 60c have a sufficient area and a plate thickness, and thus a large ground bearing capacity as a supporting member can be obtained.

[0082] Consequently, the screw-type steel pipe pile that is the third embodiment of the present invention reduces the abrasion loss of the steel-made plates 60a, 60b, and 60c, and is capable of obtaining a good ground bearing capacity. Furthermore, because the opening 63 is formed in the central region of the steel-made plates 60a, 60b, and 60c, taking in the gravel and the like can be promoted through the opening 63.

[0083] With the above-described screw-type steel pipe pile, the sacrifice members 65 are attached to the tilt-lower end portions 61a, 61b, and 61c that are the lowermost portions (distal ends) in the three steel-made plates 60a, 60b, and 60c so as to project outward in the radial direction of the steel-made plates 60a, 60b, and 60c. Consequently, as is performed on a hard ground, even when the construction is performed such that, after the pile is screwed into the ground by rotating it in a normal direction about the central axis L of the steel pipe 50, it is pulled up once by rotating it in the reverse direction

and is screwed again into the ground by rotating it in the normal direction, the construction that suppresses gaps to be formed between the ground and the tilt-lower end portions 61a, 61b, and 61c of the steel-made plates 60a, 60b, and 60c and that is excellent in straightness and in stability can be performed.

[0084] Moreover, with the above-described screw-type steel pipe pile, because the sacrifice members 65 are only arranged on the tilt-lower end portions 61a, 61b, and 61c, as compared with when the shape of the steel-made plates is adjusted such that the projection geometry of the steel-made plates becomes circular, the manufacturing of the screw-type steel pipe pile can be made easier.

[0085] Fourth Embodiment

FIG. 7 illustrates one example of a screw-type steel pipe pile that is a fourth embodiment of the present invention. FIG. 7(a) is a front view of a relevant portion of the screw-type steel pipe pile, and FIG. 7(b) is a plan view of the screw-type steel pipe pile. The screw-type steel pipe pile illustrated includes a steel pipe 70 and four steel-made plates 80a, 80b, 80c, and 80d. In the screw-type steel pipe pile illustrated in FIG. 7, a distal end side is described as the lower side and a pile head side is described as the upper side.

[0086] The steel pipe 70 is formed in a cylindrical shape having a hollow portion 71 in the inside. In the distal end portion of this steel pipe 70, four attaching portions 72a, 72b, 72c, and 72d are formed.

[0087] These attaching portions 72a, 72b, 72c, and 72d are, by dividing the distal end portion of the steel pipe 70 into four equal parts in the circumferential direction, formed along the circumferential direction of the distal end portion. In more detail, the attaching portions 72a,

72b, 72c, and 72d are contiguous via step portions 73, and the respective distal end faces tilt upward gradually from one side in the circumferential direction to the other side. The heights of the step portions 73 are assumed to be equal.

- 5 The four attaching portions 72a, 72b, 72c, and 72d illustrated are the ones that the extending lengths of the distal end faces and the tilt angles of the distal end faces are equal to one another.

[0088] The steel-made plates 80a, 80b, 80c, and 80d are
10 each formed by dividing an annular steel plate the outer diameter larger of which is than that of the steel pipe 70 into four parts, and form a fan-like shape. The outer diameter (hereinafter also referred to as blade diameter) of the annular steel plate is determined appropriately
15 depending on the condition of the ground in which the screw-type steel pipe pile is buried, the outer diameter of the steel pipe 70 (hereinafter also referred to as pile diameter), the number of steel-made plates 80a, 80b, 80c, and 80d, and others. The material used for the annular
20 steel plate is the ones having the strength equivalent to those of SM490 material and SM570 material, and its thickness (plate thickness) is made to be approximately 10 to 100 mm.

[0089] The first steel-made plate 80a is, by being
25 attached along the distal end face of the first attaching portion 72a by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 70. The outer circumferential portion of this first steel-made plate 80a is, as also illustrated in
30 FIG. 7(b), projecting outward in the radial direction of the steel pipe 70. In this first steel-made plate 80a, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 70, a

tilt-lower end portion 81a and a tilt-upper end portion 82a are formed.

[0090] The second steel-made plate 80b is, by being attached along the distal end face of the second attaching portion 72b by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 70. The outer circumferential portion of this second steel-made plate 80b is, as also illustrated in FIG. 7(b), projecting outward in the radial direction of the steel pipe 70. In this second steel-made plate 80b, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 70, a tilt-lower end portion 81b and a tilt-upper end portion 82b are formed.

[0091] The third steel-made plate 80c is, by being attached along the distal end face of the third attaching portion 72c by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 70. The outer circumferential portion of this third steel-made plate 80c is, as also illustrated in FIG. 7(b), projecting outward in the radial direction of the steel pipe 70. In this third steel-made plate 80c, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 70, a tilt-lower end portion 81c and a tilt-upper end portion 82c are formed.

[0092] The fourth steel-made plate 80d is, by being attached along the distal end face of the fourth attaching portion 72d by such as welding, attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 70. The outer circumferential portion of this fourth steel-made plate 80d is, as also illustrated in FIG. 7(b), projecting outward in the radial direction of

the steel pipe 70. In this fourth steel-made plate 80d, by being attached at an angle with respect to the direction orthogonal to the axial direction of the steel pipe 70, a tilt-lower end portion 81d and a tilt-upper end portion 82d are formed.

[0093] Then, because the four attaching portions 72a, 72b, 72c, and 72d are the ones that the extending lengths and tilt angles of the distal end faces are equal to one another as in the foregoing, the tilt angles of the steel-made plates 80a, 80b, 80c, and 80d that are attached to the respective attaching portions 72a, 72b, 72c, and 72d are equal to one another. Consequently, the tilt-lower end portions 81a, 81b, 81c, and 81d are the portions located at the lowermost positions in the four steel-made plates 80a, 80b, 80c, and 80d.

[0094] In such a screw-type steel pipe pile, the ratio of the blade diameter to the pile diameter is made to be 1.5 to 3, for example.

[0095] Because the steel-made plates 80a, 80b, 80c, and 80d are structured by dividing an annular steel plate, as illustrated in FIG. 7(b), the above-described screw-type steel pipe pile has an open-end structure in which a substantially circular opening 83 is formed in the central region of the steel-made plates 80a, 80b, 80c, and 80d near the distal end of the steel pipe 70.

[0096] Meanwhile, because the foregoing step portions 73 are formed, portions that are open on the lateral side are formed at the distal end of the steel pipe 70. However, such portions may be closed with closure members not depicted and may not be closed. While the strength of the screw-type steel pipe pile can be improved when such portions are closed with the closure members, they make taking in the gravel inside the steel pipe 70 easier when

such portions are not closed.

[0097] Note that, as illustrated in FIG. 7(b), between the steel-made plates 80a, 80b, 80c, and 80d contiguous to one another, gaps are slightly formed. As for such gaps, they may be left as they are or, for example, by making the sum total of the interior angles of the steel-made plates 80a and others exceed 360° , the gaps may be made not to appear when viewed from the upper side (pile head side) or from the lower side (distal end side).

[0098] In the above-described steel-made plates 80a, 80b, 80c, and 80d, on the lower surfaces of the tilt-lower end portions 81a, 81b, 81c, and 81d that are located at the lowermost positions, sacrifice members 85 are each attached by such as welding. These sacrifice members 85 are structured with an excavating blade and the like, for example. The material for these sacrifice members 85 is not specifically limited, and the strength thereof is selected appropriately according to the strength of the ground that is a subject of excavation.

[0099] These sacrifice members 85 are, in the respective tilt-lower end portions 81a, 81b, 81c, and 81d, attached so as to project outward in the radial direction than the steel-made plates 80a, 80b, 80c, and 80d including the tilt-lower end portions 81a, 81b, 81c, and 81d. As for the projecting lengths (overhanging lengths) of the sacrifice members 85 from the steel-made plates 80a, 80b, 80c, and 80d, it is preferable that the ratios of the lengths of the sacrifice members 85 projecting outward in the radial direction with respect to the blade diameter be 0.05 or less.

[0100] In the above-described screw-type steel pipe pile, the steel-made plates 80a, 80b, 80c, and 80d are each attached at an angle with respect to the direction

orthogonal to the axial direction of the steel pipe 70.

Thus, in the projection geometry that is formed on the land surface when the central axis L of the steel pipe 70 is placed so as to be orthogonal to the land surface, the line segment running through the central axis L of the steel pipe 70 and each of the tilt-lower end portions 81a, 81b, 81c, and 81d of the respective steel-made plates 80a, 80b, 80c, and 80d is the shortest diameter.

[0101] When the screw-type steel pipe pile having the above-described structure is given a turning force to rotate about the central axis L of the steel pipe 70 and brought into contact with the land surface, the tilt-lower end portion 81a is the portion to penetrate the ground first in the first steel-made plate 80a, the tilt-lower end portion 81b is the portion to penetrate the ground first in the second steel-made plate 80b, the tilt-lower end portion 81c is the portion to penetrate the ground first in the third steel-made plate 80c, and the tilt-lower end portion 81d is the portion to penetrate the ground first in the fourth steel-made plate 80d. Moreover, these four tilt-lower end portions 81a, 81b, 81c, and 81d are the portions located at the lowermost positions in the four steel-made plates 80a, 80b, 80c, and 80d, and thus are starting-end portions that first penetrate the ground in the four steel-made plates 80a, 80b, 80c, and 80d.

[0102] Then, when the screw-type steel pipe pile is screwed into the ground by the screw action of the projecting portions of the four steel-made plates 80a, 80b, 80c, and 80d, the sacrifice members 85, by being rotated about the central axis L of the steel pipe 70, make contact with the ground and abrade away, thereby reducing the rate of abrading the outer circumferential portions of the steel-made plates 80a, 80b, 80c, and 80d. Thus, the

abrasion loss of the steel-made plates 80a, 80b, 80c, and 80d is reduced.

[0103] As a result, when the screw-type steel pipe pile is buried in the ground, the abrasion loss of the steel-made plates 80a, 80b, 80c, and 80d is reduced and the steel-made plates 80a, 80b, 80c, and 80d have a sufficient area and a plate thickness, and thus a large ground bearing capacity as a supporting member can be obtained.

[0104] Consequently, the screw-type steel pipe pile that is the fourth embodiment of the present invention reduces the abrasion loss of the steel-made plates 80a, 80b, 80c, and 80d, and is capable of obtaining a good ground bearing capacity. Furthermore, because the opening 83 is formed in the central region of the steel-made plates 80a, 80b, 80c, and 80d, taking in the gravel and the like can be promoted through the opening 83.

[0105] With the above-described screw-type steel pipe pile, the sacrifice members 85 are attached to the tilt-lower end portions 81a, 81b, 81c, and 81d that are the lowermost portions (distal ends) in the four steel-made plates 80a, 80b, 80c, and 80d so as to project outward in the radial direction of the steel-made plates 80a, 80b, 80c, and 80d. Consequently, as is performed on a hard ground, even when the construction is performed such that, after the pile is screwed into the ground by rotating it in a normal direction about the central axis L of the steel pipe 70, it is pulled up once by rotating it in the reverse direction and is screwed again into the ground by rotating it in the normal direction, the construction that suppresses gaps to be formed between the ground and the tilt-lower end portions 81a, 81b, 81c, and 81d of the steel-made plates 80a, 80b, 80c, and 80d and that is excellent in straightness and in stability can be performed.

[0106] Moreover, with the above-described screw-type steel pipe pile, because the sacrifice members 85 are only arranged on the tilt-lower end portions 81a, 81b, 81c, and 81d, as compared with when the shape of the steel-made plates is adjusted such that the projection geometry of the steel-made plates becomes circular, the manufacturing of the screw-type steel pipe pile can be made easier.

[0107] As in the foregoing, the first to fourth embodiments that are the preferred embodiments of the present invention have been explained. The invention, however, is not limited to these and various modifications can be made.

[0108] In the above-described first embodiment, the sacrifice members 25 are attached to the lower surfaces of the tilt-lower end portions 21a and 21b by such as welding. However, in the present invention, as illustrated in FIG. 8, a sacrifice member 25' may be attached on the lateral side of the tilt-lower end portion 21a by such as welding, and as illustrated in FIG. 9, a sacrifice member 25" may be attached on the upper surface of the tilt-lower end portion 21a by such as welding.

[0109] In the above-described first to fourth embodiments, it has been exemplified that the tilt angles of the steel-made plates 20a and others that are attached to the attaching portions 12a and others are the same, assuming that the tilt angles of the distal end faces 12a1 and others of the respective attaching portions 12a and others are the same. However, in the present invention, the steel-made plates may be placed in the form that the tilt angles thereof are different from one another. In that case, the sacrifice member only needs to be attached to the tilt-lower end portion that is located at the most-distal end of a plurality of steel-made plates.

[0110] In the above-described first to fourth embodiments, the sacrifice members 25 and others are attached to the tilt-lower end portions 21a and others that are located at the most-distal end of the steel-made plates 20a and others. However, in the present invention, the sacrifice member may appropriately be placed as necessary at other places in addition to the tilt-lower end portions that are located at the most-distal end.

[0111] In the above-described first to fourth embodiments, the steel-made plates 20a and others have been attached to the distal end portions of the steel pipes 10 and others. However, in the present invention, the steel-made plates may be provided, not limited only to the distal end portions of the steel pipe, on the lateral circumferential surface.

[0112] In the above-described first to fourth embodiments, the steel-made plates 20a and others have been structured by dividing an annular steel plate. However, in the present invention, the steel-made plates may be structured by dividing a circular steel plate, and an opening for taking in the gravel may be formed, by cutting out the central region in a circle before being attached to the steel pipe, or after being attached to the steel pipe.

Reference Signs List

25	[0113]	10	STEEL PIPE
		11	HOLLOW PORTION
		12a	ATTACHING PORTION
		12b	ATTACHING PORTION
		13a	STEP PORTION
30		13b	STEP PORTION
		20a	STEEL-MADE PLATE
		20b	STEEL-MADE PLATE
		21a	TILT-LOWER END PORTION

21b TILT-LOWER END PORTION
22a TILT-UPPER END PORTION
22b TILT-UPPER END PORTION
23 OPENING
5 24a CENTRAL PORTION
24b CENTRAL PORTION
25 SACRIFICE MEMBER
g LAND SURFACE
G GROUND
10 L CENTRAL AXIS

CLAIMS

1. A screw-type steel pipe pile that is structured by attaching a plurality of steel-made plates, which are formed by dividing a circular steel plate having an outer diameter larger than that of a cylindrical steel pipe into substantially fan-like shapes, along a circumferential direction of the steel pipe at an angle with respect to a direction orthogonal to an axial direction of the steel pipe, and has an opening in a central region of the steel-made plates, the screw-type steel pipe pile comprising:
a sacrifice member configured to project outward in a radial direction from a most-distal end of the steel-made plates.
2. The screw-type steel pipe pile according to claim 1, further comprising a plurality of attaching portions that are formed at distal end portions of the steel pipe along a circumferential direction, and formed with respective distal end faces being made to gradually tilt toward a distal end side from one side in the circumferential direction to the other side, wherein
the steel-made plates are attached along the respective distal end faces of the attaching portions.
3. The screw-type steel pipe pile according to claim 1 or 2, wherein a ratio of a length of the sacrifice member projecting outward in the radial direction with respect to the outer diameter of the circular steel plate is 0.05 or less.