

[TITLE OF THE INVENTION] CABLE BODY ANCHORING FITTING

[Technical Field]

[0001]

This invention relates to a cable body anchoring fitting for anchoring a cable body such as a wire rope.

[Background Art]

[0002]

A fitting using a wedge is used as a fitting for anchoring a cable body such as a wire rope. Patent Document 1 discloses a technique related to such a fitting using a wedge (wedge clamp).

The wedge clamp disclosed in Patent Document 1 has good workability, and has a high fixing efficiency.

[Prior Art Publication]

[Patent Document]

[0003]

[Patent Document 1]

Japan Patent No. 6009611

[Summary of the Invention]

[Problems to be Solved by the Invention]

[0004]

As described in Patent Document 1, the wedge clamp disclosed in Patent Document 1 has an excellent fastening force due to its configuration where slipping between the cable body and the wedge member is prevented when tension is applied to the cable body, and the cable body and the wedge member as an integral part enter a restraining member (cylindrical member) to obtain a higher fastening force.

[0005]

This invention relates to a fitting using such a wedge (cable body anchoring fitting), in which an object of this invention is

to provide a cable body anchoring fitting having a higher fastening force with a wedge shape that is not conventionally available.

[Means for Solving the Problem]

[0006]

(Configuration 1)

A cable body anchoring fitting including a fitting member including a cylindrical body portion into which a cable body is inserted, and a driving member having a wedge-shaped portion to be inserted into the cylindrical body portion and abutting the cable body in the cylindrical body portion, in which an inclination surface of the wedge-shaped portion has an inclination at an inclination axis along a driving direction of the driving member.

[0007]

(Configuration 2)

A cable body anchoring fitting including a fitting member including a cylindrical body portion into which a cable body is inserted, and a driving member having a wedge-shaped portion to be inserted into the cylindrical body portion and abutting the cable body in the cylindrical body portion, in which, provided that a direction to which the driving member is driven is a driving direction; a direction along a thickness of the driving member and orthogonal to the driving direction is a thickness direction; and a direction orthogonal to the driving direction and the thickness direction is a width direction, an inclination surface of the wedge-shaped portion includes an inclination component to the driving direction and an inclination component to the width direction.

[0008]

(Configuration 3)

A cable body anchoring fitting according to Configuration 2 in which an inclination angle θ of the inclination surface of the

wedge-shaped portion in the driving direction, an inclination angle α of the inclination surface of the wedge-shaped portion in the width direction, a relative angle ψ relative to the driving direction which is a divided component angle of a pressing force for driving the driving member, and an apparent inclination angle α_0 when the inclination angle θ is viewed from a direction along the divided component angle have a relationship of Equation 1.

[0009]

[Equation 1]

$$\tan \alpha = \frac{\tan \theta + \sin \psi \times \tan \alpha_0}{2 \cos^2 \psi}$$

[0010]

(Configuration 4)

The cable body anchoring fitting according to any of Configurations 1 to 3, in which a concavo-convex portion is formed on a portion of the driving member abutting the cable body.

[Effect of the Invention]

[0011]

According to the cable body anchoring fitting of this invention, it is possible to provide a cable body anchoring fitting having a higher fastening force by a wedge shape that is not conventionally available.

[Brief Description of the Drawings]

[0012]

[FIG.1] FIG. 1 shows a fitting member of the cable body anchoring fitting of an embodiment according to this invention.

[FIG.2] FIG. 2 shows a driving member of the cable body anchoring fitting of the embodiment.

[FIG. 3] FIG. 3 shows a cable body anchoring fitting of the embodiment.

[FIG. 4] FIG. 4 shows a state of use of the cable body anchoring

fitting of the embodiment.

[FIG. 5] FIG. 5 is an explanatory view regarding an inclination surface of the wedge shape of the cable body anchoring fitting.

[FIG. 6] FIG. 5 is an explanatory view regarding an inclination surface of the wedge shape of the cable body anchoring fitting.

[FIG. 7] FIG. 7 shows another example of the driving member.

[FIG. 8] FIG. 8 shows the cable body anchoring fitting of the example.

[FIG. 9] FIG. 9 is an explanatory view regarding a tensile test.

[FIG. 10] FIG. 10 is a photograph of the tensile test.

[FIG. 11] FIG. 11 is a photograph of the tensile test.

[FIG. 12] FIG. 12 shows the cable body anchoring fitting of the comparative example.

[Embodiment for Carrying Out the Invention]

[0013]

The embodiment of this invention is described concretely below together with the drawings. Incidentally, the embodiment given below is one of the embodiments upon embodying this invention and is not intended to limit the invention within such a scope.

[0014]

FIG. 1 shows a fitting member of a cable body anchoring fitting of an embodiment according to this invention, and FIG. 2 shows a driving member.

Further, FIGS. 3 and 4 show the cable body anchoring fitting of this embodiment.

The cable body anchoring fitting 1 includes:

a fitting member 11 including a cylindrical body portion into which a cable body is inserted, and

a driving member 12 having a wedge-shaped portion to be inserted into the cylindrical body portion of the fitting member 11 and abutting the cable body 2 in the cylindrical body portion,

for use in anchoring, etc. an end of a cable body 2 of a wire rope, etc. More specifically, the wedge-shaped portion of the driving member 12 and the cable body 2 are inserted into the cylindrical body portion of the fitting member 11, and the driving member 12 is driven to thereby restrain the cable body 2 by the pressure generated based on the wedge shape of the driving member 12.

In the following description, a front side (left side in FIG. 3) in the driving direction (left direction in FIG. 3) of the driving member 12 is referred to as the "tip end side", and the opposite side (right side in FIG. 3) is referred to as "rear end side". The direction along the thickness of the driving member 12 that is orthogonal to the driving direction (vertical direction in FIG. 3) is the thickness direction, and the direction that is orthogonal to the driving direction and the thickness direction (direction orthogonal to the sheet in FIG. 3) is the width direction.

[0015]

FIG. 1 shows the fitting member 11, FIG. 1(a) is a top view (viewed from the top of the thickness direction), FIG. 1(b) is a side view (viewed from the width direction), and FIG. 1(c) is a rear view (viewed from the rear side).

The fitting member 11 in this embodiment is a cylindrical member in a basic configuration, and a through hole 11H is formed inside the fitting member 11 for inserting the driving member 12 and the cable body 2.

As shown in FIG. 1(c), contact surfaces 113a, 113b, which are in contact with the cable body 2 on two surfaces, are formed on the lower side of the thickness direction of the through hole 11H, thereby forming a V-shaped groove. The function of restraining the cable body 2 by two surfaces of the V-shaped groove is the

same as that of Patent Document 1, and a detailed description thereof will be omitted. Prevention of slipping between the V-shaped groove and the cable body 2 by setting the angle of the two surfaces of the V-shaped groove to a predetermined angle is as described in Patent Document 1, which is highly preferable; however, it is not essential to the application of this invention.

An upper surface (upper side in the thickness direction) inside the through hole 11H has a first inclination surface 11T1 having a first inclination angle (relative angle to the bottom surface of the through hole 11H). A rear end side into which the driving member 12 is inserted has a second inclination surface 11T2 having a second inclination angle (relative angle to the bottom surface of the through hole 11H). The second inclination surface 11T2 is a surface that engages a second inclination surface 12T2 of the driving member 12 upon insertion of the driving member 12 to be described below. Further, the first inclination surface 11T1 is a surface that engages a first inclination surface 12T1 of the driving member 12 upon insertion of the driving member 12. The second inclination surface 11T2 and the first inclination surface 11T1 each have an inclination corresponding to the inclination of the second inclination surface 12T2 and the first inclination surface 12T1 of the driving member 12 described below.

[0016]

Formed on an upper surface (upper side of the thickness direction) of the fitting member 11 is a thickness relief 111 for reducing the weight. As understood from FIG. 1, the thickness relief 111 is formed such that the amount of cutting is increased toward the front side in a side view.

Engaging parts 112 for engaging a jig used for driving the driving member 12 are formed on both sides (both sides in the width direction). Since the jig is not directly related to this invention,

the description is omitted.

[0017]

FIG. 2 shows the driving member 12, FIG. 2(a) is a top view, FIG. 2(b) is a side view, and FIG. 2(c) is a rear view.

The driving member 12 is a wedge-shaped member formed by the first inclination surface 12T1. Provided on a tip end side of the driving member 12 is a second inclination surface 12T2 having an inclination angle larger than that of the first inclination surface 12T1. The inclination angle of the first inclination surface 12T1 or the second inclination surface 12T2 is a relative angle of the first inclination surface 12T1 or the second inclination surface 12T2 relative to the bottom surface of the driving member 12, namely, an angle of the wedge shape.

The first inclination surface 12T1 (and the second inclination surface 12T2) is formed having an inclination component in the driving direction and an inclination component in the width direction. In other words, the first inclination surface 12T1 (and the second inclination surface 12T2) has an inclination at the inclination axis along the driving direction, in addition to an inclination at the inclination axis along the width direction.

[0018]

FIG. 3 is a side view showing the state of use (before driving the driving member 12) of the cable body anchoring fitting 1, and FIG. 4 is a rear view showing the state of use (while driving the driving member 12) of the cable body anchoring fitting 1.

As shown in FIG. 3, by the driving member 12 being driven into the cylindrical body portion with the cable body 2 inserted into the cylindrical body portion of the fitting member 11, the cable body 2 is restrained by the pressure generated based on the wedge shape of the driving member 12.

In the cable body anchoring fitting 1 of this embodiment, the second inclination surface 12T2 having a greater inclined angle is formed on the tip end side of the driving member 12, and a corresponding second inclination surface 11T2 is formed on the fitting member 11, so that the driving member 12 has excellent workability at the beginning of driving.

[0019]

FIG. 5 is an explanatory view of the wedge-shaped inclination surface of the driving member 12.

FIG. 5(a) is a top view of the wedge shape of the driving member 12, and FIG. 5(b) shows the inclination angle of the inclination of the wedge shape in the driving direction. The details of each symbol in FIG. 5 are as follows.

l : length of the wedge shape in the driving direction

θ : inclination angle of the wedge-shaped inclination surface in the driving direction

α : inclination angle of the wedge-shaped inclination surface in the width direction

ψ : divided component angle of a pressing force for driving the driving member 12, which is a relative angle to the driving direction, where a maximum fastening force is obtained at $\psi = 45^\circ$

α_0 : apparent inclination angle when the inclination angle θ is viewed from the direction along the divided component angle (direction A in FIG. 5)

θ_0 : apparent inclination angle when the inclination angle θ is viewed from the direction along the other divided component angle (direction B in FIG. 5)

[0020]

Based on FIG. 5, a relational equation for α is obtained as follows.

[0021]

[Equation 2]

$$\overline{a a''} = \frac{l}{2} \tan \theta$$

$$\begin{aligned} \overline{a a'''} &= \overline{a a''} + \frac{l}{2} \sin \psi \times \tan \alpha_0 \\ &= \frac{l}{2} \tan \theta + \frac{l}{2} \sin \psi \times \tan \alpha_0 \\ &= \frac{l}{2} (\tan \theta + \sin \psi \times \tan \alpha_0) \end{aligned}$$

$$\tan \alpha = \frac{l(\tan \theta + \sin \psi \times \tan \alpha_0)}{2(l \cos^2 \psi)} = \frac{\tan \theta + \sin \psi \times \tan \alpha_0}{2 \cos^2 \psi}$$

[0022]

Namely, α has the following relational equation.

[0023]

[Equation 3]

$$\tan \alpha = \frac{\tan \theta + \sin \psi \times \tan \alpha_0}{2 \cos^2 \psi}$$

[0024]

If $\theta = 3^\circ$ and $\psi = 45^\circ$, $\alpha_0 = 4.2^\circ$, so that α is 6° .

[0025]

Next, referring to FIG. 6, a description will be given regarding a vertical load W that generates a fastening force on a wedge (driving member) upon application of a pressing force F for driving the wedge (hereinafter referred to as "fastening force W "). The details of each symbol in FIG. 6 are as follows.

F : pressing force for driving the wedge

θ : inclination angle of the wedge-shaped inclination surface in the driving direction

N : resistance on the wedge-shaped inclination surface upon

application of the pressing force F

P : horizontal component of resistance N

W : vertical component of resistance N (fastening force)

[0026]

Based on FIG. 6, a relational equation for W is obtained as follows.

[0027]

[Equation 4]

$$\begin{aligned} F &= P + N\mu \cos \theta + W\mu \\ &= N \sin \theta + N\mu \cos \theta + W\mu = N(\sin \theta + \mu \cos \theta) + W\mu \end{aligned}$$

$$N = \frac{W}{\cos \theta} \text{ であるから}$$

$$\begin{aligned} F &= \frac{W}{\cos \theta} (\sin \theta + \mu \cos \theta) + W\mu = W(\tan \theta + \mu) + W\mu \\ &= W(\tan \theta + 2\mu) \end{aligned}$$

[0028]

Namely, W has the following relational equation.

[0029]

[Equation 5]

$$W = \frac{F}{\tan \theta + 2\mu}$$

[0030]

According to the cable body anchoring fitting 1 of this embodiment, a higher fastening force can be obtained by a wedge shape that is not conventionally available.

The inclination of the conventional wedge has only an inclination component in the driving direction, namely, only an inclination at the inclination axis along the width direction.

On the other hand, in addition to the inclination component

in the driving direction, the cable body anchoring fitting 1 of this embodiment is formed with an inclination component in the width direction, namely, also has an inclination at the inclination axis along the driving direction. Due to such a unique wedge shape, a higher fastening force can be obtained with respect to the pressing force upon driving the wedge.

[0031]

FIG. 7 shows another example of the driving member. The driving member 12' of FIG. 7 has a concavo-convex portion 122 formed at a portion where the driving member 12' abuts the cable body 2. Thus, the occurrence of slipping between the driving member 12' and the cable body 2 is prevented.

[0032]

In this embodiment, a cylindrical fitting member 11 is used as an example; however, this invention is not limited thereto. For example, a square columnar shape may be formed with a through hole through which the driving member or the cable body is inserted.

Further, while an example is given in this embodiment where the fitting member is formed generally cylindrical, this invention is not limited thereto, and the fitting member may have a configuration other than cylindrical as long as the fitting member has a cylindrical body portion. Similarly, while an example is given in this embodiment where the driving member is generally wedge-shaped, this invention is not limited thereto, and the driving member may have a configuration other than the wedge-shaped portion as long as the driving member is provided with a wedge-shaped portion.

[0033]

While an example is given in this embodiment where the contact surface (V-shaped groove) in contact with the cable body 2 on two surfaces is formed on the fitting member 11 side, the V-

shaped groove may be formed at a portion of the driving member 12 in contact with the cable body 2.

[0034]

(Example)

Next, a description will be made on the example and results of a tensile test for verifying the fixing efficiency.

FIG. 8 shows the cable body anchoring fitting 1 of the example. The cable body anchoring fitting of the example is the cable body anchoring fitting having the configuration described in the above embodiment, which is formed of S45C (carbon steel material) with the dimension shown in FIG. 8 (unit: mm). FIGS. 8(a) and 8(b) show the fitting member 11, and FIGS. 8(c)-8(e) show the driving member 12.

A tensile test for verifying the fixing efficiency was carried out with respect to the cable body anchoring fitting 1 of the example, using a high strength cable laid rope of $\Phi 22$ having a load capacity of 304.0 kN.

As shown in the conceptual diagram in FIG. 9, the tensile test was carried out by fastening the cable body anchoring fitting 1 to one end of the wire rope 2, casting the other end into a mold together with molten alloy to form an end portion 3, and abutting the cable body anchoring fitting 1 and the end portion 3 provided on both ends to a locking die 4 and pulling the cable body anchoring fitting 1 and the end portion 3. The wire rope 2 itself is loosely fitted to the locking die 4 (not fixed to the locking die 4), and the fixing efficiency of the cable body anchoring fitting 1 is verified by abutting respective end surfaces of the cable body anchoring fitting 1 and the end portion 3 on the locking die 4 and widening the space between the locking dies 4.

FIG. 10 and FIG. 11 are photographs showing the state of the experiment, and FIG. 10 is before the tension and FIG. 11 is after

the tension (after breaking).

[0035]

Three wire ropes 2 (high strength cable laid ropes of $\Phi 22$) were prepared, and the tensile test was carried out three times, with the following result. In all cases, the result sufficiently exceeded 75% of the standard breaking load, which is a target value.

First time: breaking load 284.0 kN, fixing efficiency 93.4%

Second time: breaking load 275.0 kN, fixing efficiency 90.4%

Third time: breaking load 255.0 kN, fixing efficiency 83.9%

[0036]

(Comparative Example)

FIG. 12 shows a cable body anchoring fitting 100 as a comparative example (unit of dimension is mm).

The cable body anchoring fitting 100 is similar to the cable body anchoring fitting 1 of the example in that a wedge-shaped member (wedge body 102A, wedge body 102B) and a cable body are inserted into a cylindrical fitting member 101 and the cable body 2 is restrained by the pressure generated by driving the wedge. On the other hand, the inclination surface of the wedge has only an inclination component in the driving direction as in conventional cases.

The cable body anchoring fitting 100 is provided with a wedge body of two stages including the wedge body 102A and the wedge body 102B so as to reduce impact force necessary for driving and to reduce enlargement of the fitting.

[0037]

A fastening fitting using a wedge utilizes a fastening force generated by driving the wedge. Namely, the fastening force is obtained by a thicker portion being driven based on the wedge shape. For example, in order to obtain a high tightening force on

a relatively flexible rope, a thicker portion should be driven. In order to improve this workability, it is conceivable to increase the inclination angle of the wedge shape. This will enable driving a thicker portion relative to a small driving distance. In this case, however, although the driving distance is shortened, an impact force required for driving is increased, which may cause reduction in workability. On the other hand, when the inclination angle of the wedge shape is reduced, the impact force required for driving can be reduced; however, the driving distance required for driving a thicker portion is increased. Long driving distance means that the size of the wedge needs to be increased, causing the fitting to increase in size.

On the other hand, what is provided with a wedge body of two stages including the wedge body 102A and the wedge body 102B so as to reduce an impact force necessary for driving and to reduce enlargement of the fitting is the cable body anchoring fitting 100. [0038]

A tensile test for verifying the fixing efficiency was carried out with respect to the cable body anchoring fitting 100 of the comparative example, using a high strength cable laid rope of $\Phi 22$ having a load capacity of 304.0 kN.

The conditions are the same as in the tensile test of the example, except for the use of the cable body anchoring fitting 100 of the comparative example instead of the cable body anchoring fitting 1 of the example (tested for only once).

As a result, the breaking load was 280.0 kN and the fixing efficiency was 92.1%.

[0039]

Although the cable body anchoring fitting 100 of the comparative example is a fitting which has been miniaturized as described above, the cable body anchoring fitting 1 of the example

is further miniaturized as is clear from the comparison between FIG. 8 and FIG. 12.

The cable body anchoring fitting 1 of the example has a unique wedge shape having an inclination component in the width direction in addition to an inclination component in the driving direction, so that a high fastening force can be obtained, to thereby obtain a fastening force equal to or greater than that of the comparative example (larger fitting) in spite of a smaller fitting.

[Description of Reference Numerals]

[0040]

1 Cable body anchoring fitting

11 Fitting member

12 Driving member

12T1 First inclination surface

12T2 Second inclination surface

122 Concavo-convex portion

θ Inclination angle of the wedge-shaped inclination surface in the driving direction

α Inclination angle of the wedge-shaped inclination surface in the width direction

CLAIMS

[Claim 1]

A cable body anchoring fitting comprising:

a fitting member comprising a cylindrical body portion into which a cable body is inserted; and

a driving member having a wedge-shaped portion to be inserted into the cylindrical body portion and abutting the cable body in the cylindrical body portion,

wherein an inclination surface of the wedge-shaped portion has an inclination at an inclination axis along a driving direction of the driving member.

[Claim 2]

A cable body anchoring fitting comprising:

a fitting member comprising a cylindrical body portion into which a cable body is inserted; and

a driving member having a wedge-shaped portion to be inserted into the cylindrical body portion and abutting the cable body in the cylindrical body portion,

wherein, provided that a direction to which the driving member is driven is a driving direction; a direction along a thickness of the driving member and orthogonal to the driving direction is a thickness direction; and a direction orthogonal to the driving direction and the thickness direction is a width direction, an inclination surface of the wedge-shaped portion comprises an inclination component to the driving direction and an inclination component to the width direction.

[Claim 3]

A cable body anchoring fitting according to Claim 2 wherein:

an inclination angle θ of the inclination surface of the wedge-shaped portion in the driving direction,

an inclination angle α of the inclination surface of the

wedge-shaped portion in the width direction,

a relative angle ψ relative to the driving direction which is a divided component angle of a pressing force for driving the driving member, and

an apparent inclination angle α_0 when the inclination angle θ is viewed from a direction along the divided component angle have a relationship of Equation 1.

[Equation 1]

$$\tan \alpha = \frac{\tan \theta + \sin \psi \times \tan \alpha_0}{2 \cos^2 \psi}$$

[Claim 4]

The cable body anchoring fitting according to any of claims 1 to 3, wherein a concavo-convex portion is formed on a portion of the driving member abutting the cable body.