

Description

Title of Invention: JACKING PIPE CUSHIONING MATERIAL, AND JACKING PIPE

Technical Field

[0001]

The present invention relates to a jacking pipe cushioning material for use in joint portions of jacking pipes in jacking construction and to a jacking pipe including the cushioning material.

Background Art

[0002]

In public sewerage construction work, jacking construction is widely employed as a construction method for burial construction work in which pipes are buried in the ground. Jacking construction is a construction method for burying pipes in the ground by, for example, successively pushing pipes made of concrete into the ground without excavating the entire region for burying pipes. In this specification, such pipes buried in the ground are hereinbelow referred to as "jacking pipes."

[0003]

Jacking pipes used in the above jacking construction are often made of materials such as concrete, resin concrete, ceramic, or iron. Accordingly, if jacking pipes come into contact with each other at the time of being pushed, contacting portions of the jacking pipes are easily damaged. In order to prevent damage of the jacking pipes and to transmit the jacking force for jacking the jacking pipes, a jacking pipe cushioning material which functions as a jacking force transmitting material is attached to the end portions of the jacking pipes.

[0004]

As the jacking pipe cushioning material, those made of expanded polystyrene, plywood, particle boards or like are used. Among these, the cushioning material made of expanded polystyrene is widely used as it has a specific feature that an arbitrary collapsing characteristic

can be realized by changing an expansion factor. A preferred example of such a jacking force transmitting material is described in Patent Literature 1. This jacking force transmitting material is a low-expansion molded article that is made of expanded polystyrene and has a specific gravity of 0.3 to 0.8. The jacking force transmitting material is also a plate member forming a ring shape as a whole.

[0005]

A cushioning material that is an elastic material has swelling deformation in a radial direction caused by the pressure acting at the time of jacking. Accordingly, the cushioning material adversely protrudes outward in the radial direction from the jacking pipes if the width in the radial direction and attaching position of the cushioning material are not appropriately adjusted. The protrusion of the cushioning material in outer peripheral portions of the jacking pipes may possibly deform a collar provided on the outer periphery of the jacking pipes. Accordingly, the width of the cushioning material in the radial direction is conventionally made smaller than a pipe wall thickness of the jacking pipes, and the cushioning material is positioned and placed so that the cushioning material does not protrude from the cross section of the pipes at the time of jacking.

[0006]

In the case of large jacking pipes having an external diameter of more than 1 m, it is general that a ring-shaped cushioning material is divided into a plurality of pieces, the divided pieces are molded, and at the time of being used, the molded pieces are stuck onto the cross sections of the pipes with adhesives and the like while being positioned thereon. However, the positioning operation requires extraordinary skills and it is also laborious to conduct works such as pressing the pieces of cushioning material until the adhesives are dried to prevent displacement of the cushioning material. Therefore, the operating efficiency of these general operating steps is not sufficient. A concrete jacking pipe cushioning material as a solution to this problem is described in Patent Literature 2.

[0007]

As shown in Figure 7, a cushioning material 1 which is made of expanded polystyrene and which forms a ring in a plurality of pieces includes projections 2 provided on an outer

peripheral portion thereof. The concrete jacking pipe cushioning material 1 is easy to position by bringing the projections 2 of the outer peripheral portion into contact with a collar provided on the outer peripheral portion of a jacking pipe. Further, only the top ends of the projections 2 are made to come into contact with the collar. Accordingly, the influence of the swelling of the cushioning material, caused by collapsing of the cushioning material which occurs at the time of jacking due to a Poisson's ratio, can be limited into a narrow region of the top ends of the projections 2. As a result, deformation of the collar is also prevented.

Citation List

Patent Literature

[0008]

Patent Literature 1: JP Patent Publication (Kokoku) No. 61-8320 B (1986)

Patent Literature 2: JP Patent Publication (Kokai) No. 8-82192 A (1996)

Summary of Invention

Technical Problem

[0009]

As described above, the concrete jacking pipe cushioning material having a shape shown in Figure 7 can effectively prevent a collar attached to the jacking pipe from being deformed at the time of jacking. However, since projections are formed on the outer peripheral portion of the material, regions without a cushioning material are formed between the jacking pipe cushioning material and the collar. Accordingly, regions which come into a surface contact with the end surface of the jacking pipe are reduced in proportion to the regions without a cushioning material as compared with the cushioning materials having no projection. Consequently, dispersion of stress is restricted, and the stress acting on the end surface of the jacking pipe via the cushioning material concentrates as compared with the stress in the case where the entire surface of the end surface is in surface contact with the cushioning material. As a result, the cushioning material having projections is poor in cushioning performance than the cushioning material which comes into a surface contact with

the entire surface of the end surface of the jacking pipe and which demonstrates high stress dispersibility thereby.

[0010]

The present invention has been made in view of the problems described above, and has as its object to provide a jacking pipe cushioning material which is easy to position and which can achieve a high stress dispersion effect, and to provide a jacking pipe having the jacking pipe cushioning material fixed to one end surface on the side with a collar attached thereto.

Solution to Problem

[0011]

A jacking pipe cushioning material according to the present invention is a plate member including at least: a first lateral surface and a second lateral surface which are positioned substantially in parallel with each other at a specified interval; and an outer peripheral surface positioned on a side of outer peripheral edges of both the lateral surfaces, the jacking pipe cushioning material forming a ring shape as a whole, wherein inequalities $A \geq B$ and $A > C$ are satisfied where A is a diameter from a center of the ring to the outer peripheral edge of the first lateral surface, B is a diameter to the outer peripheral edge of the second lateral surface, and C is a diameter to an arbitrary position on the outer peripheral surface in an axial direction.

[0012]

In the jacking pipe cushioning material according to a preferable aspect of the present invention, an inequality $A > B$ is satisfied, and the outer peripheral surface is an inclined surface continuing from the outer peripheral edge of the first lateral surface to the outer peripheral edge of the second lateral surface.

[0013]

In the above jacking pipe cushioning material, the outer peripheral surface is positioned in an inner side in the radial direction from the position of the outer peripheral edges of the first lateral surface and the second lateral surface. Therefore, even when both or either one of the outer peripheral edges of the first lateral surface and the second lateral surface are in

contact with the cylindrical collar attached to one end side of the jacking pipe, the outer peripheral surface does not come into contact with the collar and a space is formed between an inner peripheral surface of the collar and the outer peripheral surface of the jacking pipe cushioning material.

[0014]

Therefore, in the jacking pipe cushioning material according to the present invention, both or either one of the outer peripheral edges of the first lateral surface and the second lateral surface are in the state of being brought into contact with the cylindrical collar attached to one end side of the jacking pipe. Consequently, it becomes easy to conduct positioning of the jacking pipe cushioning material at the jacking pipe. Further, the aforementioned space can absorb swelling of the cushioning material in the radial direction, so that deformation of the collar caused by swelling can be prevented.

[0015]

Further, the jacking pipe cushioning material according to the present invention forms a ring shape as a whole and does not have any projection and the like. Therefore, if the first lateral surface of the cushioning material is placed so as to cover the entire surface of the end surface of the jacking pipe on the side with the collar attached thereto, stress which acts on the end surface of the jacking pipe via the cushioning material at the time of construction can be dispersed across the entire surface of the end surface of the jacking pipe. As a result, the cushion effect of the jacking pipe cushioning material is enhanced, while damage of the jacking pipe caused by stress concentration can be avoided effectively.

[0016]

The jacking pipe cushioning material according to the present invention can be obtained as an integrally molded article as a whole when the jacking pipe cushioning material is applied to jacking pipes with a small external diameter. However, when the jacking pipe cushioning material is used in large jacking pipes having an external diameter of more than 1 m, the jacking pipe cushioning material should preferably be constituted of two or more cushioning material pieces which are divided in a circumferential direction and which are

substantially identical in shape. In such a case, each of the cushioning material pieces is designed to satisfy the conditions of $A \geq B$ and $A > C$.

[0017]

When the jacking pipe cushioning material according to the present invention is constituted of a plurality of aforementioned cushioning material pieces, the left and right lateral end surfaces of each cushioning material piece may be formed as inclined end surfaces. In this aspect, when the ring-shaped jacking pipe cushioning material constituted of a plurality of cushioning material pieces is compressed at the time of jacking, swelling of the cushioning material pieces in the circumferential direction can be absorbed in a V-shaped space formed between the inclined lateral end surfaces of adjacent cushioning material pieces. Consequently, it becomes possible to suppress waving and peeling generated when the cushioning material pieces are pushed to each other by the swelling.

[0018]

Further, the present invention also discloses a jacking pipe, including: a cylindrical collar attached to one end side of the jacking pipe; and a jacking pipe cushioning material according to any one of the above descriptions, the jacking pipe cushioning material being fixed so that the first lateral surface comes into contact with the one end surface of the jacking pipe on the side with the collar attached thereto.

[0019]

In this jacking pipe, the stress acting on the end surface can effectively be dispersed via the jacking pipe cushioning material. Therefore, it becomes possible to avoid damage of the end surface side caused by stress concentration at the time of construction. It also becomes possible to avoid deformation of the collar at the time of jacking.

Advantageous Effects of Invention

[0020]

According to the present invention, a jacking pipe cushioning material can be obtained which is easy to position, which can be expected to provide a high stress dispersion effect, and which can further prevent deformation of the collar attached to the jacking pipe. Moreover, a

jacking pipe can be obtained which can avoid damage of the end surface caused by stress concentration.

Brief Description of Drawings

[0021]

[Figure 1] Figure 1 is a cross sectional view taken along a longitudinal direction of a joint portion of jacking pipes using a jacking pipe cushioning material according to the present invention.

[Figure 2] Figure 2 is a view explaining a placement state of jacking pipe cushioning material pieces in the jacking pipe according to the present invention.

[Figure 3] Figure 3(a) is a perspective view showing an example of a cushioning material piece in the jacking pipe cushioning material according to the present invention and Figure 3(b) is a cross sectional view taken along a line b - b of Figure 3(a).

[Figure 4] Figure 4 is a view equivalent to Figure 3(b) showing another example of the cushioning material piece in the jacking pipe cushioning material according to the present invention.

[Figure 5] Figure 5(a) is a perspective view showing still another example of the cushioning material piece in the jacking pipe cushioning material according to the present invention and Figure 5(b) is a cross sectional view taken along a line b - b of Figure 5(a).

[Figure 6] Figure 6 is a front view showing a part of the cushioning material pieces shown in Figure 5 being connected in a ring shape.

[Figure 7] Figure 7 is a view showing an example of a conventional jacking pipe cushioning material.

Description of Embodiments

[0022]

Hereinafter, the embodiments of the present invention will be described with reference to the drawings.

[0023]

In Figure 1, reference numeral 10 denotes a cylindrical jacking pipe made of, for example, concrete and reference character L denotes a central axis line. A cylindrical collar 11 made of sheet steel and the like is attached to a rear end portion (socket side) of a jacking pipe 10A that is a front jacking pipe in a jacking direction. A front end portion (spigot side) of a jacking pipe 10B that is a rear jacking pipe in the jacking direction is fitted into the collar 11, the front end portion being formed to have a diameter reduced in some degree. A jacking pipe cushioning material 20 formed in a ring shape having the central axis line L as a central axis is stuck onto a rear end surface 12 of the front jacking pipe 10A with use of adhesives and the like. At the time of jacking, the front end portion of the rear jacking pipe 10B is fitted into the collar 11 as described before, and a front end surface 13 thereof comes into contact with the jacking pipe cushioning material 20. It is to be noted that the jacking pipe cushioning material 20 may be made of a material same as that of conventionally used jacking pipe cushioning materials, such as low-expansion molded articles which are made of expanded polystyrene and which have a specific gravity of 0.3 to 0.8. In Figure 1, reference numeral 14 denotes an appropriate sealant, and reference numeral 15 denotes a setting margin to set mortar and the like, the setting margin being formed on an inner-diameter side of the rear end surface of the jacking pipe 10A.

[0024]

Figure 2 is a cross sectional view taken along a line a - a of Figure 1. In this illustrated example, the jacking pipe cushioning material 20 is constituted of a plurality of cushioning material pieces 20a (16 pieces in the illustrated example) which are divided in a circumferential direction and which are substantially in an identical fan-shape. Hereinafter, the jacking pipe cushioning material 20 of the present invention will be explained with the cushioning material pieces 20a as an example.

[0025]

The fan-shaped cushioning material piece 20a is a plate member with a thickness s, the plate member including: a first lateral surface 21 and a second lateral surface 22 which are positioned substantially in parallel with each other at a specified interval s; an outer peripheral

surface 25; left and right lateral end surfaces 26 and 27; and an inner peripheral surface 28 as shown in Figure 3.

[0026]

Both an outer peripheral edge 23 of the first lateral surface 21 and an outer peripheral edge 24 of the second lateral surface 22 form an arc. A distance (curvature radius) A from the center of the arc, i.e., from a central axis line L of the cylindrical jacking pipe 10 to the outer peripheral edge 23 of the first lateral surface 21 is larger than a distance (curvature radius) B from the central axis line L to the outer peripheral edge 24 of the second lateral surface 22 as shown in Figure 2.

[0027]

In the illustrated example, the outer peripheral surface 25 present between the outer peripheral edge 23 and the outer peripheral edge 24 forms a slant face which inclines continuously from the outer peripheral edge 23 toward the outer peripheral edge 24 side. That is, a relation of $A > C$ is satisfied where C is a distance (curvature radius) from the central axis line L to an arbitrary position on the outer peripheral surface 25 in a central axis line L direction. The inner peripheral surface 28 forms a cylindrical surface in the illustrated example, though it is not an essential component feature.

[0028]

In the cushioning material piece 20a, a distance from the outer peripheral edge 23 in the first lateral surface 21 to the inner peripheral surface 28 is preferably almost identical to a length of the rear end surface of the jacking pipe 10A in the radial direction (in the example shown in Figure 1, the jacking pipe 10A has a setting margin 15 formed on the inner diameter side of the rear end surface, and so the distance from the outer peripheral edge 23 in the first lateral surface 21 to the inner peripheral surface 28 is shortened in proportion to the size of the setting margin 15, though it is not an essential component feature). The aforementioned distance (curvature radius) A from the central axis line L to the outer peripheral edge 23 of the first lateral surface 21 is made equal to a distance (curvature radius) D from the central axis line L in the rear end surface 12 of the jacking pipe 10A to the collar 11 (see Figure 1).

[0029]

At the start of jacking construction, the above-stated cushioning material pieces 20a are stuck onto the entire periphery of the rear end surface 12 of the jacking pipe 10A with use of adhesives so that the first lateral surface 21 side faces the rear end surface 12 side. The curvature radius A of the outer peripheral edge 23 of the first lateral surface 21 is equal to the curvature radius D of the outer peripheral edge in the rear end surface 12 of the jacking pipe 10A which is in contact with the collar 11. Consequently, an operator can easily form a ring-shaped jacking pipe cushioning material 20 constituted of 16 cushioning material pieces 20a as shown in Figure 2 by sticking all the cushioning material pieces 20a while positioning the outer peripheral edge 23 in the state of being in contact with the collar 11. The thus-formed jacking pipe cushioning material 20 ends up in the state of covering the entire surface of the rear end surface 12 of the jacking pipe 10A.

[0030]

The jacking pipe 10A is buried in the ground, and the jacking pipe 10B is inserted into the collar 11 positioned on the rear end portion of the jacking pipe 10A. Thus, jacking construction is continued. As shown in Figure 1, the top end surface 13 of the rear jacking pipe 10B comes into contact with the second lateral surface 22 of the jacking pipe cushioning material 20 (cushioning material pieces 20a). As a consequence, the cushioning material pieces 20a are compressed and jacking force is transmitted. The cushioning material pieces 20a swell out in a radial direction by the compression, and this swelling phenomenon appears in such a way that the inclined outer peripheral surfaces 25 of the aforementioned cushioning material pieces 20a are pushed outward. However, since the outer peripheral surfaces 25 are formed as inclined surfaces as mentioned above, a space p is formed between the outer peripheral surface 25 and the inner peripheral surface of the collar 11 as shown in Figure 1. Accordingly, the swelled portion, i.e., the portion pushed outward, is absorbed in the space p, so that a large force is not applied to the collar 11. As a result, the collar 11 is prevented from being deformed. The outer peripheral edge 23 of the first lateral surface 21 is in contact with the inner peripheral surface of the collar 11, and outward swelling of that portion acts as force applied onto the collar 11. However, the contact area is too small to produce enough force to cause deformation of the collar 11.

[0031]

Moreover, the jacking force is transmitted to the front jacking pipe 10A via the first lateral surface 21 of the cushioning material piece 20a. It is possible, as described above, to bring the first lateral surfaces 21 of the cushioning material pieces 20a into a surface contact with the entire surface of the rear end surface 12 of the jacking pipe 10A. Accordingly, at the time of construction, the stress acting on the rear end surface 12 of the jacking pipe 10A via the cushioning material pieces 20a can be dispersed over the entire surface of the rear end surface 12 of the jacking pipe 10A. As a result, the cushion effect of the jacking pipe cushioning material 20 (cushioning material pieces 20a) is enhanced, while damage of the jacking pipe 10A caused by stress concentration can be avoided effectively.

[0032]

Although size relation between the area of the second lateral surfaces 22 of the cushioning material pieces 20a and the area of the front end surface 13 of the jacking pipe 10B may be arbitrary, the preferable aspect is an aspect in which both the areas are equal in size or the second lateral surfaces 22 are slightly larger.

[0033]

Figure 4 shows another aspect of the cushioning material piece 20a on cross section. In Figure 4, component members corresponding to those of the cushioning material piece 20a shown in Figure 3 are designated by corresponding reference numerals. In Figure 4(a), the aforementioned distance (curvature radius) A and the distance (curvature radius) B are equal. The outer peripheral surface 25 present between the outer peripheral edge 23 and the outer peripheral edge 24 is constituted of inclined surfaces 25a and 25b which are inclined in two reverse directions. The inclined surfaces 25a and 25b are connected so that generally central portions in a width direction are the lowest. In the cushioning material piece 20a shown in Figure 4(b), the outer peripheral surface 25 is made into a curved shape in an arc with respect to the center in a cross sectional shape.

[0034]

Figure 5 shows still another aspect of the cushioning material piece 20a on cross section. Figure 5(a) is a perspective view and Figure 5(b) is a cross sectional view taken

along a line b - b of Figure 5(a). The cushioning material piece 20a shown in Figure 5 is different from the cushioning material piece 20a shown in Figure 3 in the point that left and right lateral end surfaces 26a and 27a are inclined surfaces so that the second lateral surface 22 side is narrower as shown in Figure 5(b). Other structural aspects are identical to those shown in Figure 3, and identical component members are designated by identical reference numerals.

[0035]

Figure 6 shows the state where a plurality of cushioning material pieces 20a shown in Figure 5 stuck to the rear end surface 12 of the jacking pipe 10A in a ring shape as shown in Figure 2. As shown in the drawing, in each cushioning material piece 20a, the left and right lateral end surfaces 26a and 27a are inclined in a direction which makes the second lateral surface 22 narrower than the first lateral surface 21. Consequently, a V-shaped space p1 is formed between one lateral end surface 26a and the other lateral end surface 27a of the adjacent cushioning material pieces 20a. When the ring-shaped jacking pipe cushioning material 20 is compressed at the time of jacking, the cushioning material pieces 20a also swell in a circumferential direction. However, since the V-shaped space p1 can absorb the swelling in the circumferential direction, the cushioning material pieces 20a in this shape can suppress waving and peeling generated when the cushioning material pieces are pushed to each other by the swelling.

Reference Signs List

[0036]

L ... Central axis line of jacking pipe,

10, 10A, 10B ... Jacking pipe,

11 ... Collar,

12 ... Rear end surface of jacking pipe,

13 ... Front end surface of jacking pipe,

20 ... Ring-shaped jacking pipe cushioning material,

20a ... Cushioning material pieces which constitute jacking pipe cushioning material

21 ... First lateral surface,
22 ... Second lateral surface,
23 ... Outer peripheral edge of first lateral surface
24 ... Outer peripheral edge of second lateral surface,
25 ... Outer peripheral surface,
26, 27 ... left and right lateral end surfaces,
28 ... Inner peripheral surface,
L ... Central axis line of jacking pipe,
A ... Distance (curvature radius) from central axis line L of cylindrical jacking pipe to outer peripheral edge of first lateral surface,
B ... Distance (curvature radius) from central axis line L of cylindrical jacking pipe to outer peripheral edge of second lateral surface,
C ... Distance from central axis line L of cylindrical jacking pipe to arbitrary position on outer peripheral surface in central axis line L direction, D Distance (curvature radius) from central axis line L in rear end surface of jacking pipe to collar.

Claims

[Claim 1]

A jacking pipe cushioning material which is a plate member, comprising at least:

a first lateral surface and a second lateral surface which are positioned substantially in parallel with each other at a specified interval; and

an outer peripheral surface positioned on a side of outer peripheral edges of both the lateral surfaces, the jacking pipe cushioning material forming a ring shape as a whole, wherein

inequalities $A \geq B$ and $A > C$ are satisfied where A is a diameter (curvature radius) from a center of the ring to the outer peripheral edge of the first lateral surface, B is a diameter (curvature radius) to the outer peripheral edge of the second lateral surface, and C is a diameter (curvature radius) to an arbitrary position on the outer peripheral surface in an axial direction.

[Claim 2]

The jacking pipe cushioning material according to claim 1, wherein

an inequality $A > B$ is satisfied, and

the outer peripheral surface is an inclined surface continuing from the outer peripheral edge of the first lateral surface to the outer peripheral edge of the second lateral surface.

[Claim 3]

The jacking pipe cushioning material according to claim 1 or 2, comprising:

two or more cushioning material pieces which are divided in a circumferential direction and which are substantially identical in shape, wherein

each of the cushioning material pieces satisfies the conditions of $A \geq B$ and $A > C$.

[Claim 4]

The jacking pipe cushioning material according to claim 3, wherein

each of the cushioning material pieces has both end surfaces formed as inclined surfaces.

[Claim 5]

A jacking pipe, comprising:

a cylindrical collar attached to one end side of the jacking pipe; and

a jacking pipe cushioning material according to any one of claims 1 to 4, the jacking pipe cushioning material being fixed so that the first lateral surface comes into contact with the one end surface of the jacking pipe on a side with the collar attached thereto.