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Description

BACKGROUND OF THE INVENTION

[0001] The invention relates to a continuous pile to be mounted in the ground and/or in rock, and particularly to a pile according to the preamble of claim 1, which pile is formed of two or more metal pipe parts joined to each other successively and comprising an external thread provided at at least one end, the pile further comprising one or more sleeves for joining two successive pipe parts to each other, which sleeve comprises a first end and a second end as well as a first internal thread in the vicinity of the first end and a second internal thread in the vicinity of the second end. The invention further relates to a pile joint and particularly to a pile joint according to the preamble of claim 15 for joining two successive metal pipe parts to each other, the pile joint comprising a first pipe part provided with an external thread at its end or in the vicinity thereof; and a second pipe part provided with an external thread at its end or in the vicinity thereof; as well as a sleeve provided with a first internal thread in the vicinity of a first end for engaging with the external thread of the first pipe part and a second internal thread in the vicinity of a second end for engaging with the external thread of the second pipe part to join the first and the second pipe part to each other.

[0002] In substructure construction, the piles must withstand the stresses caused by the mounting, i.e. penetration into the ground and/or rock, and meet the requirements of the building regulations, for example, with regard to the compression and tensile strengths, bending stiffness and torque. The piles may be subjected to great vertical and/or horizontal loads during the mounting or after it. Bending is caused to the piles by eccentric load and/or curvature of the piles. The required total extent of the piles is often so great that the piles must be made of two or more pile parts joined to each other successively. In extended piles like this, particularly high requirements are imposed on the strength and stiffness of the joints.

[0003] In accordance with the prior art, piles may, if required, be extended by welding but it is slow to carry out the welding in construction site conditions. On the other hand, there should be a qualified welder on the construction site all the time although welded joints need to be made only occasionally. This leads to an uneconomical situation. Presently, there are also threaded sleeves with which piles can be extended. The present known conical threaded sleeves, such as known from EP1010815, transmit forces reasonably well but in certain cases their bending stiffness does not meet the requirements imposed on the stiffness of a joint, and thus known sleeves cannot be used for extending piles in all conditions. Splice sleeves attached to the inside of a pile pipe prevent removal of the drilling means from the inside of the pile after the mounting, which is an uneconomical solution because drilling means are expensive.

BRIEF DESCRIPTION OF THE INVENTION

[0004] An object of the invention is to provide a pile and a pile joint in such a way that the above problems can be solved. The object of the invention is achieved with a pile according to claim 1. The object of the invention is further achieved with a pile joint according to claim 15.

[0005] Preferred embodiments of the invention are disclosed in the dependent claims.

[0006] The present invention is based on providing a pile and a pile joint which comprises a sleeve for receiving and joining to each other two pile pipe parts to be mounted successively. The sleeve comprises a first and a second internal thread provided in the vicinity of the sleeve ends. Correspondingly, the pipe parts are provided at their ends or in the vicinity of the ends with external threads matching the internal threads of the sleeve part in such a way that the pipe parts can be joined to each other by means of the sleeve by fastening the pipe parts to the sleeve by means of said threads. The sleeve is further provided on its inner surface with first counter surfaces provided at the ends of the sleeve in such a way that they extend towards the centre of the sleeve in the direction of the sleeve axis. The counter surfaces are arranged to become positioned against the outer surface of the pipe part when the pipe part is in place inside the sleeve. The pipe part may also be provided with second plane-like counter surfaces in such a way that the first counter surfaces of the sleeve part become positioned tightly against the second counter surfaces of the pipe part when the pipe part is in place in the sleeve. Plane-like counter surfaces refer to substantially even and smooth surfaces which do not comprise any threads. In accordance with the above, the first counter surfaces provided in the sleeve extend as an extension of the internal threads of the sleeve to the inner surface of the sleeve, to the sleeve ends.

[0007] An advantage of the present invention is that these counter surfaces provided on the inner surface of the sleeve at the sleeve ends and becoming positioned tightly against the outer surface of the pipe part or against special counter surfaces provided on the outer surface of the pipe significantly improve the stiffness, particularly bending stiffness, of the pile joint and thus of the whole pile formed of pipe parts. In other words, the pile and pile joint according to the invention withstand the loads directed at the piles and pile joint during the use and the mounting and meet the requirements imposed on the stiffness of a pile joint. Further, the solution according to the invention allows the drilling means to be removed after the mounting of the pile.

BRIEF DESCRIPTION OF THE FIGURES

[0008] The invention will now be described in greater detail in connection with preferred embodiments, referring to the attached drawings, of which:

Figure 1 shows a pile joint according to the prior art;
Figure 2 shows a sleeve of the pile joint of Figure 1;
Figure 3 shows a pile according to the present invention, comprising joints for joining successive pipe parts to each other;
Figure 4 shows a pile joint according to the present invention for joining two successive pipe parts of the pile to each other by means of a sleeve; and
Figure 5 shows a portion of the pile joint of Figure 4 open, the pipe part being separate from the sleeve.

DETAILED DESCRIPTION OF THE INVENTION AND THE FIGURES

[0009] Figure 1 shows a pile joint according to the prior art. The pile is formed of two or more metal pipe parts 30, 32 joined to each other successively and by means of an external sleeve 34. In accordance with Figure 1, the ends of the pipe parts 30, 32 are provided with external threads, the sleeve being provided with internal threads matching them. In accordance with Figure 1, the pipe parts are screwed on the sleeve by its opposite ends in such a way that the face areas of the ends of the pipe parts become positioned against each other.

[0010] Figure 2 shows an external sleeve 34 according to the prior art for a pile joint, the sleeve comprising a first and a second thread or threaded portion 36, 38 which extend, in the direction of the centre line or axis 39 of the sleeve 34, substantially from the centre of the sleeve 34 or from the vicinity thereof to the ends 33, 35 of the sleeve. In accordance with Figures 1 and 2, both the threads 36, 38 of the sleeve 34 and the threads of the pipe parts 30, 32 are provided as taper threads. The diameter of the taper thread of the pipe parts 30, 32 decreases towards the end of the pipe part 30, 32 and, correspondingly, the diameter of the threads of the sleeve 34 increases towards the ends 33, 35 of the sleeve 34.

[0011] Figure 3 shows schematically a pile 2 according to the present invention, in which successive pipe parts 4a, 4b, 4c, 4d and 4e are joined to each other by means of a pile joint. In accordance with Figure 3, the pile 2 is mounted in the ground M and/or in rock K in such a way that the successive pipe parts 4a, 4b, 4c, 4d, 4e of the pile 2, such as of a bored pile, which are typically and preferably made of steel, are joined to each other with a pile joint 1. The pipe parts 4a, 4b, 4c, 4d, 4e are preferably pipes, whereby drilling can be carried out through them, but the pipe parts 4a, 4b, 4c, 4d, 4e may also be other types of pile parts. The pile joint 1 primarily comprises a straight sleeve 3 made of metal, typically and preferably of steel, on the inside of which there are the ends of two successive pipe parts 4a, 4b, 4c, 4d, 4e serving as extensions for each other. The bored pile 2 may be formed of at least two successive metal pipe parts 4a, 4b, 4c, 4d, 4e with threaded ends, the ends being positioned in the sleeve 3. Typically, there are three to six pipe parts and, correspondingly, there is one less of the sleeves 3 than there are pipe parts 4a, 4b, 4c, 4d, 4e, i.e. one sleeve between each successive pipe part 4a, 4b, 4c, 4d, 4e. In connection with the end of the lowest pipe part 4a of the bored pile 2, i.e. the end of the whole pile 2, there is usually a drilling means 10, such as a drill bit or the like machining ring. The use thereof is not, however, necessary for implementing the basic idea of the invention.

[0012] Figure 4 shows the pile joint 1 according to the invention in greater detail while Figure 5 shows the sleeve 3 and the end of the pipe part 4b in greater detail. The first and the second pipe part 4a and 4b are mounted on the sleeve 3 in such a way that the face areas 17 and 18 of the ends 15 and 16 of the pipe parts 4a and 4b are against each other in accordance with Figure 4, whereby the compression forces in the pipe parts 4a, 4b, 4c, 4d, 4e are transmitted via the face areas 17 and 18. The sleeve 3 according to the invention has two sets of female threads 5a and 5b, provided as internal threads or threaded portions on the inner surface of the sleeve 3. Typically, the threads 5a and 5b are taper threads which widen, i.e. the diameter of the threaded portion increases, towards ends 7a, 7b of the sleeve 3. In other words, the taper threads 5a, 5b start from the ends 7a, 7b of the sleeve and taper towards the centre of the sleeve, as shown in Figure 5. In the pile joint 1, the taper threads 5a, 5b allow the greatest wall thickness of the pipe part 4a, 4b, 4c, 4e to be positioned at the end 7a, 7b of the sleeve 3, at which a great load is directed. The pipe parts 4a, 4b are further provided, in the vicinity of the ends 15, 16 thereof, with an external thread 6. An external thread 6 is preferably a taper thread tapering towards the end 15, 16 of the pipe part 4a, 4b. In other words, the diameter of the threaded portion provided by the external thread 6 is reduced towards the end 15, 16 of the pipe part 4a, 4b.

[0013] In accordance with Figures 4 and 5, the sleeve 3 is provided with first counter surfaces X1 positioned on the inner surface of the sleeve 3 at the first and the second end 7a, 7b of the sleeve. The counter surfaces X1 are substantially plane-like or smooth surfaces having neither machined features that would deviate from the surface plane nor any threads. The first plane-like counter surfaces X1 are provided to extend, on the inner surface of the sleeve 3, from the first and the second end 7a, 7b of the sleeve 3 towards the centre of the sleeve 3 in the direction of an axis 9 of the sleeve 3. Thus, the first and the second internal thread 5a, 5b are provided to extend, on the inner surface of the sleeve 3, from the first plane-like counter surfaces X1 towards the centre of the sleeve 3 in the direction of the axis of the sleeve 3, i.e. as an extension of the counter surfaces X1 towards the end 7a, 7b of the sleeve 3.

[0014] Correspondingly, the outer surface of the pipe part 4a, 4b is provided with a second counter surface X2 in such a way that the first plane-like counter surface of the sleeve 3 and the second plane-like counter-surface X1, X2 of the pipe part 4a, 4b are arranged to become positioned tightly against each other when the pipe part 4a, 4b is in place inside the sleeve 3, at the position ac-

cording to Figure 4. The second plane-like counter surface X2 is provided to extend, on the outer surface of the pipe part 4a, 4b, in the direction of the axis 9 of the pipe part 4a, 4b. In accordance with Figures 4 and 5, the external thread 6 of the pipe part 4a, 4b is provided to extend, on the outer surface of the pipe part 4a, 4b, from the second plane-like counter surface X2 in the direction of the axis of the pipe part 4a, 4b towards the end 15, 16 of the pipe part; in other words, the external thread 6 extends as an extension of the second counter surface X2 to the outer surface of the pipe part 4a, 4b towards the end 15, 16 of the pipe part 4a, 4b. The support surfaces X1 and X2 may be support surfaces that have been machined specially and accurately. Alternatively, the first counter surface X1 of the sleeve 3 may be provided to become positioned against the outer surface of the pipe part 4a, 4b without the outer surface of the pipe part 4a, 4b comprising any other counter surface made by separate machining. In such a case, the outer surface of the pipe part 4a, 4b forms the second counter surface X2.

[0015] In accordance with Figures 4 and 5, the sleeve 3 may comprise, on its inner surface, at least one third plane-like counter surface Y1 in the direction of the axis of the sleeve 3, at the sleeve centre or in the vicinity of the centre. The third plane-like counter surfaces Y1 are provided to extend, on the inner surface of the sleeve 3, in the direction of the axis of the sleeve 3 from the first and the second internal thread 5a, 5b towards the centre of the sleeve 3, i.e. as an extension of the internal threads 5a and 5b towards the centre of the sleeve 3.

[0016] Correspondingly, the pipe part 4a, 4b may comprise, on its outer surface, a fourth plane-like counter surface Y2, whereby the third and the fourth plane-like counter surface Y1, Y2 are arranged to be positioned tightly against each other when the pipe part 4a, 4b is in place inside the sleeve 3. This fourth plane-like counter surface Y2 is provided to extend, on the outer surface of the pipe part 4a, 4b, in the direction of the pipe part 4a, 4b from its end 15, 16 towards the centre of the pipe part 4a, 4b, i.e. as an extension of the external thread 6 towards the end of the pipe part 4a, 4b. In other words, the fourth plane-like counter surface Y2 is provided to extend, on the outer surface of the pipe part 4a, 4b, from the external thread 6 to the end 15, 16 of the pipe part 4a, 4b.

[0017] Figure 5 shows a sleeve 3 and a pipe part 4b from the joint of Fig.4, where the starting and final ends of the threaded portions 5a, 5b of the sleeve 3 are provided with counter surfaces X1 and X2 which have no threads. The pipe part 4b is provided with counter surfaces X2, Y2 matching the counter surfaces X1, Y1 and being preferably of the substantially same size. A slot between the counter surfaces deteriorates the bending stiffness of the joint, so the counter surfaces need to be machined very accurately to match each other. As claimed, the counter surfaces formed in the pipe part 4b and the sleeve 3 are tightly against each other but in practice the slot must conform to the tolerance requirements of normal machining methods.

[0018] In principle, all counter surfaces X1, X2, Y1, Y2 or some of them may be at an angle relative to the centre line 9 of the pipe part 4a, 4b, 4c, 4d, 4e but in such a case the possible longitudinal movement allowed by the clearance of the threads or position deviation of the pipe parts 4a, 4b, 4c, 4d, 4e in the longitudinal direction of the sleeve 3 causes a slot between the counter surfaces X1, Y1, X2, Y2, whereby the bending stiffness of the joint deteriorates. Therefore, the counter surfaces X1, X2, Y1, Y2 are preferably parallel to the centre line or axis 9 of the pipe part 4a, 4b, 4c, 4d, 4e. Further, the parallelism of all counter surfaces X1, X2, Y1, Y2 to the centre line or axis 9 of the pipe part 4a, 4b, 4c, 4d, 4e cause the face areas 17, 18 of the pipe parts to become positioned tightly and firmly against each other in the joint, which essentially improves the bending stiffness of the pile joint.

[0019] Depending on the load directed at the pile 2 and on the required bending stiffness, one or more pairs of counter surfaces are needed between the pipe part 4a, 4b, 4c, 4d, 4e and the sleeve 3. This is primarily implemented with the first counter surfaces X1 at the beginning of the threaded portion of the sleeve 3 of the pile joint 1 and with the second counter surfaces X2 that serve as an extension of the thread 6 of the pipe part 4a, 4b, 4c, 4d, 4e, seen from the end of the pipe part 4a, 4b. Further, if required, the pile joint is also provided with a second pair of counter surfaces Y1, Y2, as explained above. The pile joint according to the invention has at least the counter surfaces X1 and X2 at the ends 7a, 7b of the sleeve 3. Preferably, the joint has also counter surfaces Y1 and Y2 at the centre of the sleeve of the pile joint 1. Preferably, the centre of the sleeve 3 is provided with a recessed bevel 11 which contributes to the accurate manufacture of the counter surfaces Y1 of the sleeve structure.

[0020] In special cases, it is feasible to add one or more counter surfaces to the middle of the threaded portion (not shown), whereby the sleeve comprises one or more plane-like counter surfaces in the middle of the threads 5a and 5b, and the pipe part comprises one or more counter surfaces in the middle of the external thread 6, which counter surfaces provided in the middle of the threads 5a, 5b and 6 are arranged to become positioned against each other when the pipe part 4a, 4b, 4c, 4d, 4e is in place inside the sleeve 3.

[0021] The length of the counter surfaces X1, X2, Y1, Y2 in the direction of the centre line 9 of the pipe part 4a, 4b, 4c, 4d, 4e is selected on the basis of the required stiffness. The length of the counter surfaces X1 at the ends of the sleeve 3 is 8 to 50 mm and preferably 10 to 30 mm. Correspondingly, the length of the counter surface Y1 at the centre of the sleeve is approximately half of the lengths of the counter surfaces X1 at the ends of the sleeve. Preferably, the length of the counter surfaces X1, X2 is thus greater than that of the counter surfaces Y1, Y2.

[0022] Diameters D3, D4 of the counter surfaces X1, X2 are, in the solution according to the invention, greater

than or equal to the greatest diameters of the internal threads 5a, 5b of the sleeve 3 and, correspondingly, diameters D1, D2 of the possible counter surfaces Y1, Y2 are smaller than or equal to the smallest diameters of the threads 5a, 5b.

[0023] Preferably, the pipe parts 4a, 4b, 4c, 4d, 4e are what are called small piles which have diameters D5 ranging from 50 to 300 mm and lengths ranging from 4 to 10 m. The pile joint 1 allows the piling, i.e. pile installation 2, to be made up to dozens of metres deep by using sleeves 3.

[0024] Thus, preferably, the diameter D2 of the fourth counter surface Y2 of the pipe part 4a, 4b, 4c, 4d, 4e is smaller than or equal to the diameter D1 of the third counter surface Y1 of the sleeve 3, and/or the diameter D4 of the second counter surface X2 of the pipe part 4a, 4b, 4c, 4d, 4e is smaller than or equal to the diameter D3 of the first counter surface X1 of the sleeve 3. Further, to enable the mounting, the diameters D1, D2 of the third and the fourth counter surface Y1, Y2 are smaller than the diameters D3, D4 of the first and the second counter surface X1, X2.

[0025] The bending stiffness EI [kNm^2] of the pile joints, i.e. splices, of rammed and bored piles is calculated with the equation

$$EI = \frac{M \cdot l^2}{8 \cdot \delta},$$

where

M = bending moment [kNm],
l = spacing of the measuring points [m], and
δ = bending of the pile between the measuring points [m].

[0026] The stiffness requirement of rammed and bored pile splices for instance according to the standard "SFS-EN 1993-5 EUROCODE 3: DESIGN OF STEEL STRUCTURES Part 5: Piling" is > 0.75 EI (pile pipe). The stiffness of a pile joint must, in accordance with the standard, be over 75% of the stiffness of the pipe part of the pile. Studies with an FEM analysis (finite element method) have indicated that in pile joints of the prior art according to Figures 1 and 2, the stiffness is approximately EI = 0.2 MNm^2. In the FEM analysis of a pile joint according to the present invention, it was surprisingly observed that providing first counter surfaces X1 and second counter surfaces X2 increased the value of the stiffness of the pile joint, EI = 1 MNm^2. In this example, M = 90 kNm, l = 1 400 mm and δ = 22 mm. On the basis of this example, it can be noted that the bending stiffness of the pile joint provided by the first and second counter surfaces X1, X2 is five-fold compared with pile joints of the prior art.

[0027] Further, it can be understood that in accordance with a preferred embodiment, using not only the first and second counter surfaces X1, X2 but also third and fourth counter surfaces Y1, Y2 further increases the stiffness of the pile joint essentially. The solution according to this embodiment is particularly well applicable to joining together large-sized pipe parts 4a, 4b, 4c, 4d, 4e, in which the loads are correspondingly greater.

[0028] It will be obvious to a person skilled in the art that as the technology advances, the invention as defined by the claims can be implemented in a plurality of ways. The invention and its embodiments are thus not restricted to the above-described examples but may vary within the scope defined by the claims.

Claims

1. A pile to be mounted in the ground and/or in rock, which pile is formed of two or more metal pipe parts (4a, 4b, 4c, 4d, 4e) joined to each other successively and comprising an external thread (6) provided at at least one end (15, 16), the pile further comprising one or more sleeves (3) for joining two successive pipe parts (4a, 4b, 4c, 4d, 4e) to each other, which sleeve (3) comprises a first end (7a) and a second end (7b) as well as a first internal thread (5a) in the vicinity of the first end (7a) and a second internal thread (5b) in the vicinity of the second end (7b), **characterized in that** the sleeve (3) comprises at its first and second end (7a, 7b) on the inner surface of the sleeve (3) a plane-like first counter surface (X1), and that the two or more metal pipe parts (4a, 4b, 4c, 4d, 4e) joined to each other successively comprise on their outer surface a second plane-like counter surface (X2), the first and the second plane-like counter surface (X1, X2) being arranged to become positioned tightly against each other when the pipe part (4a, 4b, 4c, 4d, 4e) is in place inside the sleeve (3).

2. A pile according to claim 1, **characterized in that** the first plane-like counter surfaces (X1) are provided to extend on the inner surface of the sleeve (3) from the first and the second end (7a, 7b) in the direction of the axis of the sleeve (3) towards the centre of the sleeve (3).

3. A pile according to claim 1 or 2, **characterized in that** the first and the second internal thread (5a, 5b) are provided to extend on the inner surface of the sleeve (3) from the first plane-like counter surfaces (X1) in the direction of the axis of the sleeve (3) towards the centre of the sleeve (3).

4. A pile according to any one of the preceding claims 1 to 3, **characterized in that** the second plane-like counter surfaces (X2) are provided to extend on the outer surface of the pipe part (4a, 4b, 4c, 4d, 4e) in the direction of the axis of the pipe part (4a, 4b, 4c, 4d, 4e).

5. A pile according to any one of the preceding claims 1 to 4, **characterized in that** the outer thread (6) of the pipe part (4a, 4b, 4c, 4d, 4e) is provided to extend on the outer surface of the pipe part (4a, 4b, 4c, 4d, 4e) from the second plane-like counter surface (X2) in the direction of the axis of the pipe part (4a, 4b, 4c, 4d, 4e) towards the end (15, 16) of the pipe part.

6. A pile according to any one of the preceding claims 1 to 5, **characterized in that** the sleeve (3) comprises on its inner surface at least one third plane-like counter surface (Y1) in the direction of the axis of the sleeve (3), at the sleeve centre or in the vicinity of the centre, and that the pipe part (4a, 4b, 4c, 4d, 4e) comprises on its outer surface a fourth plane-like counter surface (Y2), the third and the fourth plane-like counter surface (Y1, Y2) being arranged to become positioned tightly against each other when the pipe part (4a, 4b, 4c, 4d, 4e) is in place inside the sleeve (3).

7. A pile according to claim 6, **characterized in that** the third plane-like counter surfaces (Y1) are provided to extend on the inner surface of the sleeve (3) in the direction of the axis of the sleeve (3) from the first and the second internal thread (5a, 5b) towards the centre of the sleeve (3).

8. A pile according to claim 6 or 7, **characterized in that** the fourth plane-like counter surface (Y2) is provided to extend on the outer surface of the pipe part (4a, 4b, 4c, 4d, 4e) in the direction of the axis of the pipe part (4a, 4b, 4c, 4d, 4e) from its end (15, 16) towards the centre of the pipe part (4a, 4b, 4c, 4d, 4e).

9. A pile according to any one of the preceding claims 6 to 8, **characterized in that** the fourth plane-like counter surface (Y2) is provided to extend on the outer surface of the pipe part (4a, 4b, 4c, 4d, 4e) from the outer thread (6) to the end (15, 16) of the pipe part (4a, 4b, 4c, 4d, 4e).

10. A pile according to any of the preceding claims 6 to 9, **characterized in that** diameters (D1, D2) of the third and the fourth counter surface (Y1, Y2) are smaller than diameters (D3, D4) of the first and the second counter surface (X1, X2).

11. A pile according to any one of the preceding claims 1 to 10, **characterized in that** the counter surfaces (X1, X2, Y1, Y2) are substantially parallel to the axis of the pipe parts (4a, 4b, 4c, 4d, 4e).

12. A pile according to any one of the preceding claims 1 to 11, **characterized in that** face areas (8) of the ends (15, 16) of the pipe parts (4a, 4b, 4c, 4d, 4e) are arranged substantially against each other when the pipe part (4a, 4b, 4c, 4d, 4e) is in place inside the sleeve (3).

13. A pile according to any one of the preceding claims 6 to 12, **characterized in that** the diameter (D2) of the fourth plane-like counter surface (Y2) is smaller than or equal to the diameter of the third plane-like counter surface (Y1).

14. A pile according to any one of the preceding claims 1 to 13, **characterized in that** the internal threads (5a, 5b) are provided as a taper thread having an inner diameter which increases towards the ends (7a, 7b) of the sleeve (3), and that the outer thread (6) is provided as a taper thread having an outer diameter which decreases towards the end (15, 16) of the pipe part (4a, 4b, 4c, 4d, 4e).

15. A pile joint for joining two successive metal pipe parts (4a, 4b, 4c, 4d, 4e) to each other, the pile joint comprising a first pipe part (4a, 4b, 4c, 4d,4e) provided with an external thread (6) at its end (15) or in the vicinity thereof; and a second pipe part (4a, 4b, 4c, 4d, 4e) provided with an external thread (6) at its end (16) or in the vicinity thereof; as well as a sleeve (3) provided with a first internal thread (5a) in the vicinity of a first end (7a) for engaging with the external thread (6) of the first pipe part (4a, 4b, 4c, 4d, 4e) and a second internal thread (5b) in the vicinity of a second end (7b) for engaging with the external thread (6) of the second pipe part (4a, 4b, 4c, 4d, 4e) to join the first and the second pipe part (4a, 4b, 4c, 4d, 4e) to each other, **characterized in that** the sleeve (3) comprises at its first and second end (7a, 7b) on the inner surface of the sleeve (3) a plane-like first counter surface (X1) arranged to become positioned tightly against the outer surface (X2) of respectively the first and second pipe part (4a, 4b, 4c, 4d, 4e) when the pipe part (4a, 4b, 4c, 4d, 4e) is in place inside the sleeve (3).

Patentansprüche

1. Pfahl, der im Boden und/oder in Gestein errichtet werden soll, wobei der Pfahl aus zwei oder mehr Metallrohrteilen (4a, 4b, 4c, 4d, 4e) gebildet ist, die aufeinanderfolgend miteinander verbunden sind und ein Außengewinde (6) aufweisen, das an mindestens einem Ende (15, 16) vorgesehen ist, wobei der Pfahl weiter eine oder mehrere Hülsen (3) zum Verbinden von zwei aufeinanderfolgenden Rohrteilen (4a, 4b, 4c, 4d, 4e) miteinander umfasst, wobei die Hülse (3) ein erstes Ende (7a) und ein zweites Ende (7b) sowie ein erstes Innengewinde (5a) in der Nähe des ersten Endes (7a) und ein zweites Innengewinde (5b) in der Nähe des zweiten Endes (7b)

umfasst, **dadurch gekennzeichnet, dass** die Hülse (3) an ihrem ersten und ihrem zweiten Ende (7a, 7b) auf der Innenfläche der Hülse (3) eine ebenenartige erste Gegenfläche (X1) umfasst und dass die aufeinanderfolgend miteinander verbundenen zwei oder mehr Metallrohrteile (4a, 4b, 4c, 4d, 4e) auf ihrer Außenfläche eine zweite ebenenartige Gegenfläche (X2) umfassen, wobei die erste und die zweite ebenenartige Gegenfläche (X1, X2) angeordnet sind, um dicht aneinander positioniert zu werden, wenn das Rohrteil (4a, 4b, 4c, 4d, 4e) in der Hülse (3) platziert ist.

2. Pfahl nach Anspruch 1, **dadurch gekennzeichnet, dass** die ersten ebenenartigen Gegenflächen (X1) vorgesehen sind, um sich auf der Innenfläche der Hülse (3) von dem ersten und dem zweiten Ende (7a, 7b) in der Richtung der Achse der Hülse (3) zu der Mitte der Hülse (3) hin zu erstrecken.

3. Pfahl nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das erste und das zweite Innengewinde (5a, 5b) vorgesehen sind, um sich auf der Innenfläche der Hülse (3) von den ersten ebenenartigen Gegenflächen (X1) in der Richtung der Achse der Hülse (3) zu der Mitte der Hülse (3) hin zu erstrecken.

4. Pfahl nach einem der vorstehenden Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die zweiten ebenenartigen Gegenflächen (X2) vorgesehen sind, um sich auf der Außenfläche des Rohrteils (4a, 4b, 4c, 4d, 4e) in der Richtung der Achse des Rohrteils (4a, 4b, 4c, 4d, 4e) zu erstrecken.

5. Pfahl nach einem der vorstehenden Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** das Außengewinde (6) des Rohrteils (4a, 4b, 4c, 4d, 4e) vorgesehen ist, um sich auf der Außenfläche des Rohrteils (4a, 4b, 4c, 4d, 4e) von der zweiten ebenenartigen Gegenfläche (X2) in der Richtung der Achse des Rohrteils (4a, 4b, 4c, 4d, 4e) zu dem Ende (15, 16) des Rohrteils hin zu erstrecken.

6. Pfahl nach einem der vorstehenden Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die Hülse (3) auf ihrer Innenfläche wenigstens eine dritte ebenartige Gegenfläche (Y1) in der Richtung der Achse der Hülse (3) in der Hülsenmitte oder in der Nähe der Mitte umfasst und dass das Rohrteil (4a, 4b, 4c, 4d, 4e) an seiner Außenfläche eine vierte ebenartige Gegenfläche (Y2) umfasst, wobei die dritte und die vierte ebenartige Gegenfläche (Y1, Y2) angeordnet sind, um dicht aneinander positioniert zu werden, wenn sich das Rohrteil (4a, 4b, 4c, 4d, 4e) in der Hülse (3) platziert ist.

7. Pfahl nach Anspruch 6, **dadurch gekennzeichnet, dass** die dritten ebenenartigen Gegenflächen (Y1) vorgesehen sind, um sich auf der Innenfläche der Hülse (3) von dem ersten und dem zweiten Innengewinde (5a, 5b) in der Richtung der Achse der Hülse (3) zu der Mitte der Hülse (3) hin zu erstrecken.

8. Pfahl nach Anspruch 6 oder 7, **dadurch gekennzeichnet, dass** die vierte ebenenartige Gegenfläche (Y2) vorgesehen ist, um sich auf der Außenfläche des Rohrteils (4a, 4b, 4c, 4d, 4e) in der Richtung der Achse des Rohrteils (4a, 4b, 4c, 4d, 4e) von seinem Ende (15, 16) zu der Mitte des Rohrteils (4a, 4b, 4c, 4d, 4e) hin zu erstrecken.

9. Pfahl nach einem der vorstehenden Ansprüche 6 bis 8, **dadurch gekennzeichnet, dass** die vierte ebenenartige Gegenfläche (Y2) vorgesehen ist, um sich auf der Außenfläche des Rohrteils (4a, 4b, 4c, 4d, 4e) von dem Außengewinde (6) zu dem Ende (15, 16) des Rohrteils (4a, 4b, 4c, 4d, 4e) hin zu erstrecken.

10. Pfahl nach einem der vorstehenden Ansprüche 6 bis 9, **dadurch gekennzeichnet, dass** Durchmesser (D1, D2) der dritten und der vierten Gegenfläche (Y1, Y2) kleiner als Durchmesser (D3, D4) der ersten und der zweiten Gegenfläche (X1, X2) sind.

11. Pfahl nach einem der vorstehenden Ansprüche 1 bis 10, **dadurch gekennzeichnet, dass** die Gegenflächen (X1, X2, Y1, Y2) im Wesentlichen parallel zu der Achse der Rohrteile (4a, 4b, 4c, 4d, 4e) sind.

12. Pfahl nach einem der vorstehenden Ansprüche 1 bis 11, **dadurch gekennzeichnet, dass** Stirnflächen (8) der Enden (15, 16) der Rohrteile (4a, 4b, 4c, 4d, 4e) im Wesentlichen aneinander angeordnet sind, wenn das Rohrteil (4a, 4b, 4c, 4d, 4e) in der Hülse (3) platziert ist.

13. Pfahl nach einem der vorstehenden Ansprüche 6 bis 12, **dadurch gekennzeichnet, dass** der Durchmesser (D2) der vierten ebenenartigen Gegenfläche (Y2) kleiner oder gleich dem Durchmesser der dritten ebenenartigen Gegenfläche (Y1) ist.

14. Pfahl nach einem der vorstehenden Ansprüche 1 bis 13, **dadurch gekennzeichnet, dass** die Innengewinde (5a, 5b) als ein Konusgewinde vorgesehen sind, das einen Innendurchmesser aufweist, der zu den Enden (7a, 7b) der Hülse (3) hin zunimmt und dass das Außengewinde (6) als ein Konusgewinde vorgesehen ist, das einen Außendurchmesser aufweist, der zu dem Ende (15, 16) des Rohrteils (4a, 4b, 4c, 4d, 4e) hin abnimmt.

15. Pfahlverbindung zum Verbinden von zwei aufeinanderfolgenden Metallrohrteilen (4a, 4b, 4c, 4d, 4e)

miteinander, wobei die Pfahlverbindung ein erstes Rohrteil (4a, 4b, 4c, 4d, 4e), das an seinem Ende (15) oder in der Nähe davon mit einem Außengewinde (6) versehen ist; und ein zweites Rohrteil (4a, 4b, 4c, 4d, 4e), das an seinem Ende (16) oder in der Nähe davon mit einem Außengewinde (6) versehen ist; sowie eine Hülse (3) umfasst, die in der Nähe eines ersten Endes (7a) mit einem ersten Innengewinde (5a) zum in Eingriff bringen mit dem Außengewinde (6) des ersten Rohrteils (4a, 4b, 4c, 4d, 4e) und in der Nähe eines zweiten Endes (7b) mit einem zweiten Innengewinde (5b) zum in Eingriff bringen mit dem Außengewinde (6) des zweiten Rohrteils (4a, 4b, 4c, 4d, 4e) versehen ist, um das erste und das zweite Rohrteil (4a, 4b, 4c, 4d, 4e) miteinander zu verbinden, **dadurch gekennzeichnet, dass** die Hülse (3) an ihrem ersten und ihrem zweiten Ende (7a, 7b) auf der Innenfläche der Hülse (3) eine ebenenartige erste Gegenfläche (X1) umfasst, die angeordnet ist, um dicht an der Außenfläche (X2) des ersten bzw. des zweiten Rohrteils (4a, 4b, 4c, 4d, 4e) positioniert zu werden, wenn das Rohrteil (4a, 4b, 4c, 4d, 4e) in der Hülse (3) platziert ist.

Revendications

1. Pieu à monter dans le sol et/ou dans la roche, lequel pieu est formé de deux ou plus de parties de tuyau métalliques (4a, 4b, 4c, 4d, 4e) jointes l'une à l'autre successivement et comprenant un filet externe (6) ménagé sur au moins une extrémité (15, 16), le pieu comprenant en outre une ou plusieurs douilles (3) pour joindre deux parties de tuyau successives (4a, 4b, 4c, 4d, 4e) l'une à l'autre, laquelle douille (3) comprend une première extrémité (7a) et une seconde extrémité (7b) ainsi qu'un premier filet interne (5a) au voisinage de la première extrémité (7a) et un second filet interne (5b) au voisinage de la seconde extrémité (7b), **caractérisé en ce que** la douille (3) comprend à sa première et à sa seconde extrémité (7a, 7b) sur la surface interne de la douille (3) une première contre-surface de forme plane (X1) et les deux ou plus de parties de tuyau métalliques (4a, 4b, 4c, 4d, 4e) jointes l'une à l'autre comprennent successivement sur leur surface externe une deuxième contre-surface de forme plane (X2), la première et la deuxième contre-surface de forme plane (X1, X2) étant agencées pour se positionner étroitement l'une contre l'autre lorsque la partie de tuyau (4a, 4b, 4c, 4d, 4e) est en place à l'intérieur de la douille (3).

2. Pieu selon la revendication 1, **caractérisé en ce que** les premières contre-surfaces de forme plane (X1) sont prévues pour s'étendre sur la surface interne de la douille (3) depuis la première et la seconde extrémité (7a, 7b) dans la direction de l'axe de la douille (3) vers le centre de la douille (3).

3. Pieu selon la revendication 1 ou 2, **caractérisé en ce que** le premier et le second filet interne (5a, 5b) sont prévus pour s'étendre sur la surface interne de la douille (3) depuis les premières contre-surfaces de forme plane (X1) dans la direction de l'axe de la douille (3) vers le centre de la douille (3).

4. Pieu selon l'une quelconque des revendications précédentes 1 à 3, **caractérisé en ce que** les deuxièmes contre-surfaces de forme plane (X2) sont prévues pour s'étendre sur la surface externe de la partie de tuyau (4a, 4b, 4c, 4d, 4e) dans la direction de l'axe de la partie de tuyau (4a, 4b, 4c, 4d, 4e).

5. Pieu selon l'une quelconque des revendications précédentes 1 à 4, **caractérisé en ce que** le filet externe (6) de la partie de tuyau (4a, 4b, 4c, 4d, 4e) est prévu pour s'étendre sur la surface externe de la partie de tuyau (4a, 4b, 4c, 4d, 4e) depuis la deuxième contre-surface de forme plane (X2) dans la direction de l'axe de la partie de tuyau (4a, 4b, 4c, 4d, 4e) vers l'extrémité (15, 16) de la partie de tuyau.

6. Pieu selon l'une quelconque des revendications précédentes 1 à 5, **caractérisé en ce que** la douille (3) comprend sur sa surface interne au moins une troisième contre-surface de forme plane (Y1) dans la direction de l'axe de la douille (3), au centre de la douille ou au voisinage du centre, et la partie de tuyau (4a, 4b, 4c, 4d, 4e) comprend sur sa surface externe une quatrième contre-surface de forme plane (Y2), la troisième et la quatrième contre-surface de forme plane (Y1, Y2) étant agencées pour se positionner étroitement l'une contre l'autre lorsque la partie de tuyau (4a, 4b, 4c, 4d, 4e) est en place à l'intérieur de la douille (3).

7. Pieu selon la revendication 6, **caractérisé en ce que** les troisièmes contre-surfaces de forme plane (Y1) sont prévues pour s'étendre sur la surface interne de la douille (3) dans la direction de l'axe de la douille (3) depuis le premier et le second filet interne (5a, 5b) vers le centre de la douille (3).

8. Pieu selon la revendication 6 ou 7, **caractérisé en ce que** la quatrième contre-surface de forme plane (Y2) est prévue pour s'étendre sur la surface externe de la partie de tuyau (4a, 4b, 4c, 4d, 4e) dans la direction de l'axe de la partie de tuyau (4a, 4b, 4c, 4d, 4e) depuis son extrémité (15, 16) vers le centre de la partie de tuyau (4a, 4b, 4c, 4d, 4e).

9. Pieu selon l'une quelconque des revendications précédentes 6 à 8, **caractérisé en ce que** la quatrième contre-surface de forme plane (Y2) est prévue pour s'étendre sur la surface externe de la partie de tuyau

(4a, 4b, 4c, 4d, 4e) depuis le filet externe (6) jusqu'à l'extrémité (15, 16) de la partie de tuyau (4a, 4b, 4c, 4d, 4e).

10. Pieu selon l'une quelconque des revendications précédentes 6 à 9, **caractérisé en ce que** les diamètres (D1, D2) de la troisième et de la quatrième contre-surface (Y1, Y2) sont plus petits que les diamètres (D3, D4) de la première et de la deuxième contre-surface (X1, X2).

11. Pieu selon l'une quelconque des revendications précédentes 1 à 10, **caractérisé en ce que** les contre-surfaces (X1, X2, Y1, Y2) sont sensiblement parallèles à l'axe des parties de tuyau (4a, 4b, 4c, 4d, 4e).

12. Pieu selon l'une quelconque des revendications précédentes 1 à 11, **caractérisé en ce que** les zones faciales (8) des extrémités (15, 16) des parties de tuyau (4a, 4b, 4c, 4d, 4e) sont agencées sensiblement l'une contre l'autre lorsque la partie de tuyau (4a, 4b, 4c, 4d, 4e) est en place à l'intérieur de la douille (3).

13. Pieu selon l'une quelconque des revendications précédentes 6 à 12, **caractérisé en ce que** le diamètre (D2) de la quatrième contre-surface de forme plane (Y2) est inférieur ou égal au diamètre de la troisième contre-surface de forme plane (Y1).

14. Pieu selon l'une quelconque des revendications 1 à 13, **caractérisée en ce que** les filets internes (5a, 5b) sont prévus sous la forme d'un filet conique ayant un diamètre interne qui augmente vers les extrémités (7a, 7b) de la douille (3) et le filet externe (6) est prévu sous la forme d'un filet conique ayant un diamètre externe qui diminue vers l'extrémité (15, 16) de la partie de tuyau (4a, 4b, 4c, 4d, 4e).

15. Jonction de pieu pour joindre deux parties de tuyau métalliques successives (4a, 4b, 4c, 4d, 4e) l'une à l'autre, la jonction de pieu comprenant une première partie de tuyau (4a, 4b, 4c, 4d, 4e) pourvue d'un filet externe (6) à son extrémité (15) ou au voisinage de celle-ci ; et une seconde partie de tuyau (4a, 4b, 4c, 4d, 4e) pourvue d'un filet externe (6) à son extrémité (16) ou au voisinage de celle-ci ; ainsi qu'une douille (3) pourvue d'un premier filet interne (5a) au voisinage d'une première extrémité (7a) pour s'engager sur le filet externe (6) de la première partie de tuyau (4a, 4b, 4c, 4d, 4e) et un second filet interne (5b) au voisinage d'une seconde extrémité (7b) pour s'engager sur le filet externe (6) de la seconde partie de tuyau (4a, 4b, 4c, 4d, 4e) afin de joindre la première et la seconde partie de tuyau (4a, 4b, 4c, 4d, 4e) l'une à l'autre, **caractérisée en ce que** la douille (3) comprend à sa première et sa seconde extrémité (7a, 7b) sur la surface interne de la douille (3) une première contre-surface de forme plane (X1) agencée pour se positionner étroitement contre la surface externe (X2) de, respectivement, la première et la seconde partie de tuyau (4a, 4b, 4c, 4d, 4e) lorsque la partie de tuyau (4a, 4b, 4c, 4d, 4e) est en place à l'intérieur de la douille (3).

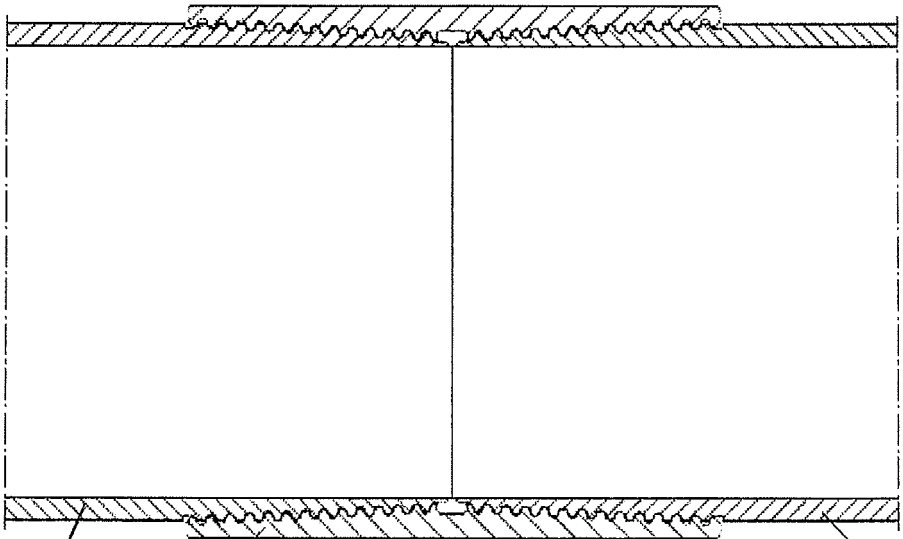


FIG. 1

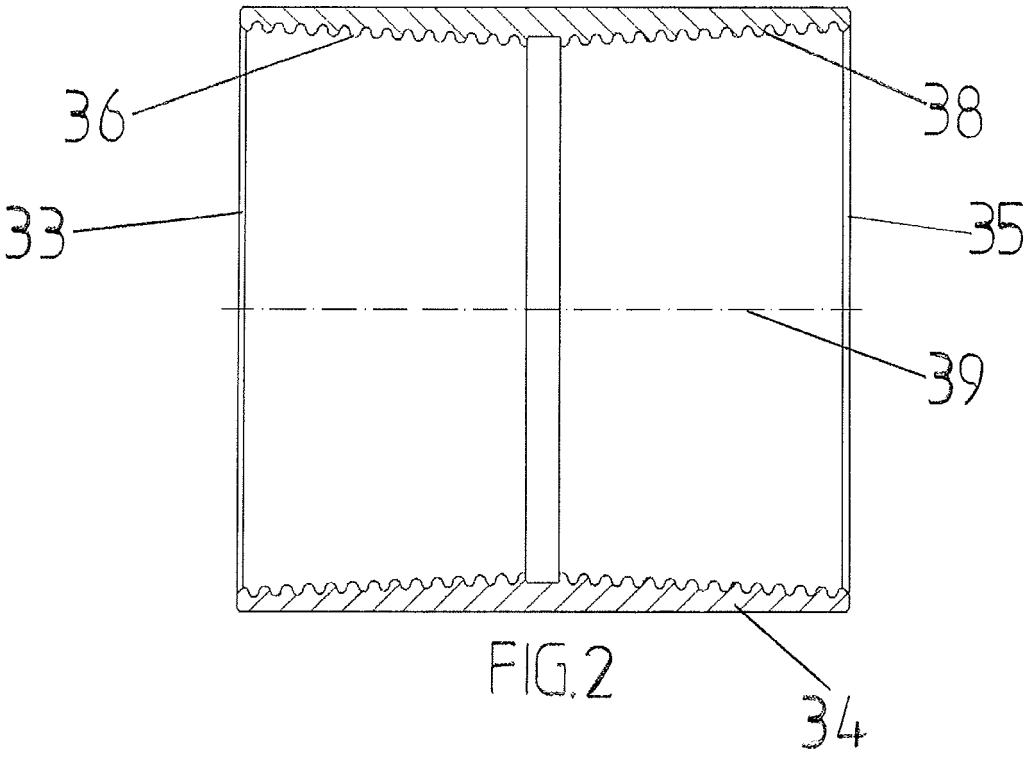


FIG. 2

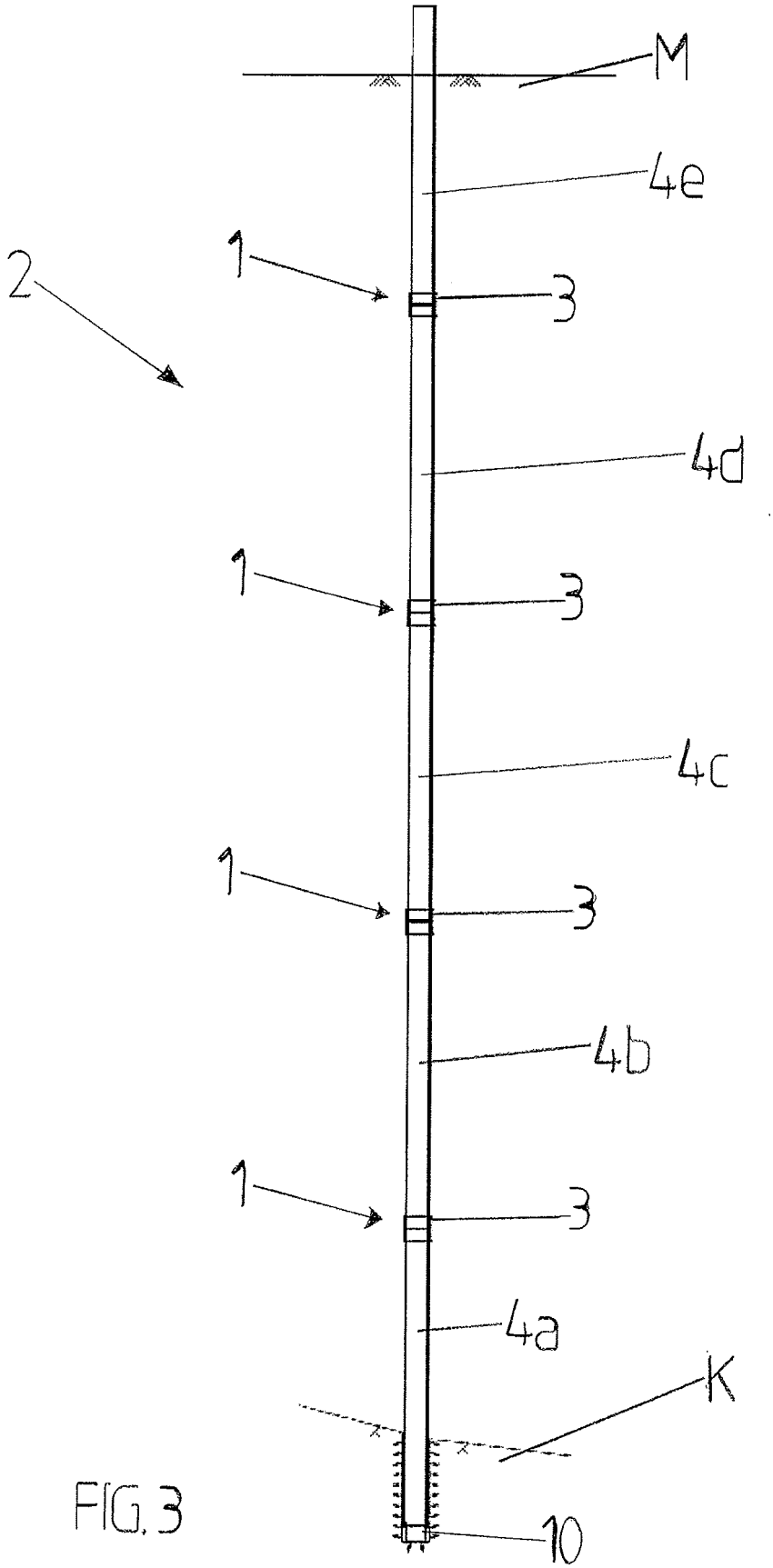


FIG. 3

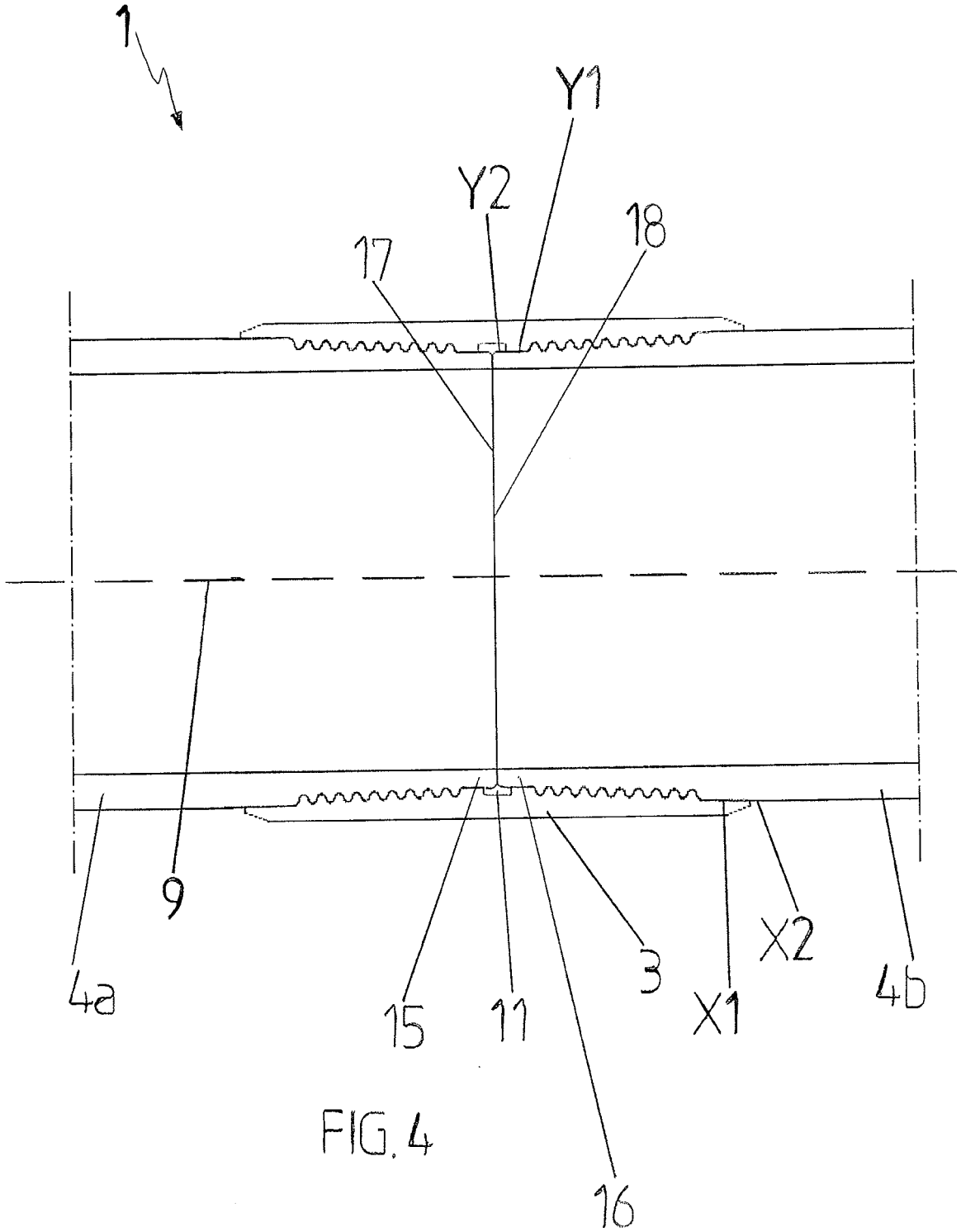


FIG. 4

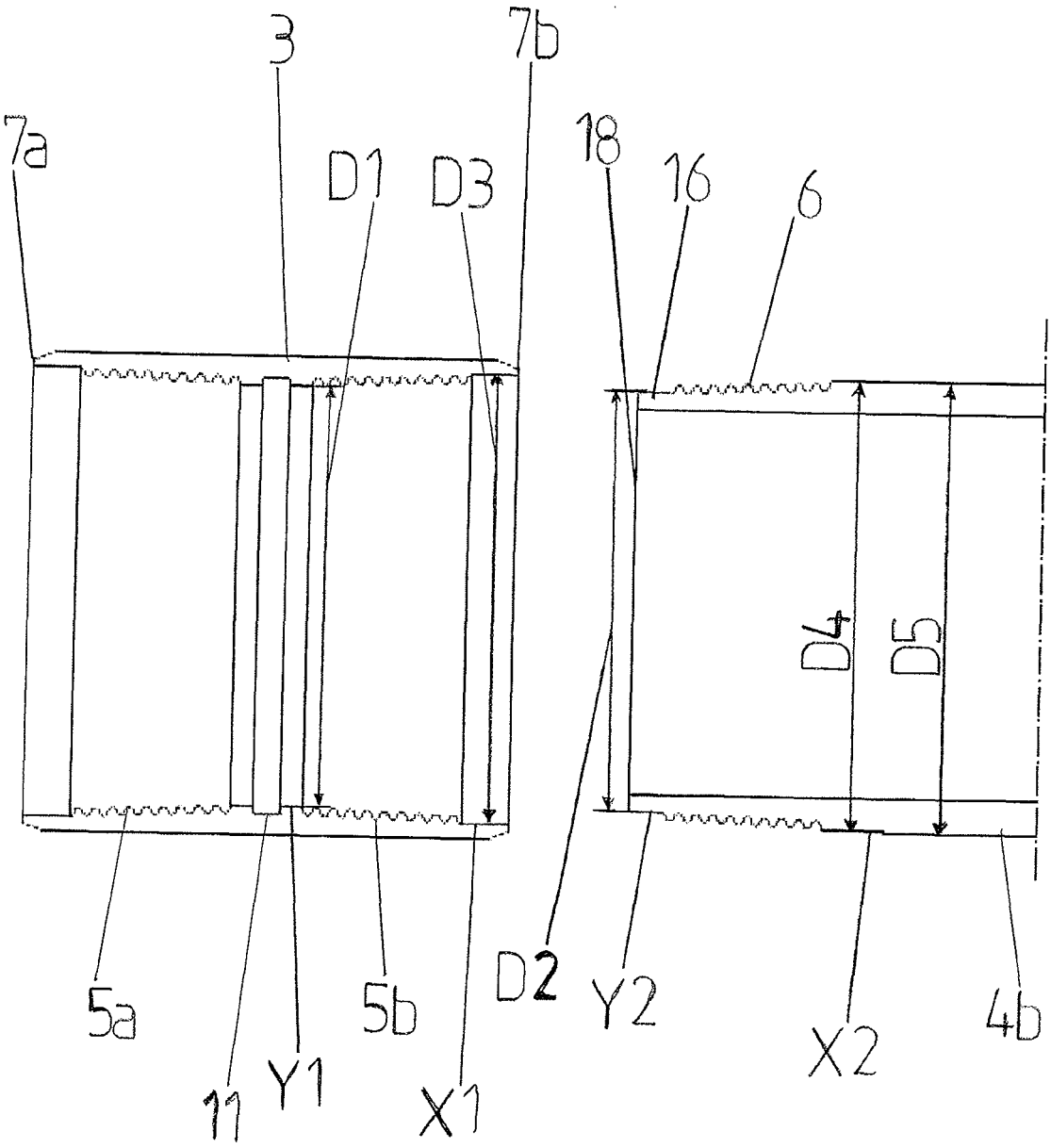


FIG.5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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