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(54) A FOUNDATION AND A METHOD OF ESTABLISHING PILE FOUNDATION

FUNDAMENT UND VERFAHREN ZUR HERSTELLUNG EINES PFAHLFUNDAMENTS

FONDATION ET PROCÉDÉ D'ÉTABLISSEMENT D'UN PIEU DE FONDATION

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Description

TECHNICAL FIELD

[0001] The present invention relates to a foundation or a pile driven foundation for an overhead line mast, power line mast or the like, comprising a reinforced concrete pile including pile threaded bolt connectors, a number of gaskets and a corresponding number of tightening nuts.

BACKGROUND OF THE INVENTION

[0002] Prefabricated concrete piles are normally used for foundations at location where the upper soil layers are not suitable for accommodating a shallow foundation. At location where the bearing capacity of the ground is weak in relation to the construction, piles are preferred option compared to shallow foundations. Through the use a piling foundation the load from the construction may be transferred from the weaker upper layers of the soil to lower stronger layers, which are typically found deeper level in the ground. The piles are driven into the ground by using a pile driver or hammer or the like.

[0003] The piles are intended for embedment deep into the ground for providing a stable foundation for various structures such as buildings, bridges and similar constructions. The pile foundation can be used in soil layers along railways.

[0004] For purposes where prefabricated concrete foundations used with threaded bolt connections it is necessary to protect the reinforcement from water penetrating into the concrete at the bolt shaft. The water will penetrate the foundations, more precisely the water will penetrate into the reinforced concrete piles between the bolt shaft and the reinforcing concrete causing the reinforcement elements of the reinforced concrete piles to corrode and eventually cause the reinforced concrete supporting the bolt shaft to break, which will reduce the stability of the overlying construction. The penetrating water may also freeze when subjected to temperatures below 0° C and cause damage to the pile. There is consequently a need for technologies for avoiding water penetration into the concrete foundation, especially reinforced concrete bolt-foundations for railway powerlines, or similar with demand for long durability being exposed to outside weather conditions.

[0005] Such prior art piles are disclosed in e.g. PL67224Y1 which discloses a foundation suitable for an overhead line mast and comprising a reinforced concrete pile including threaded bolt connectors being embedded in the concrete pile, each connector having an exposed part extending beyond a first end part and connected to reinforcement elements of the pile. The document does not disclose any improvement to the sealing capability and the prevention penetration of water into the reinforced concrete pile at the bolt shaft.

[0006] The general object of the present invention is to provide a foundation, which is able to withstand the environment impact and exposure accruing over time on the structure at the installation location.

[0007] The above need and object together with numerous other needs and objects, which will be evident from below detailed description, are according to a first aspect of the present invention obtained by a foundation for an overhead line mast, power line mast or the like, comprising a reinforced concrete pile including threaded bolt, a number of gaskets and a corresponding number of tightening nuts:

- the reinforced concrete pile defining an elongated structure having a first end part including a planar abutment surface of a first polygonal geometry and a second end part, steel reinforcement elements extending between the first end part and the second end parts, the threaded bolt connectors being embedded in the reinforced concrete pile and each having an exposed part extending beyond the first end part and positioned in a second polygonal geometry and connected to the steel reinforcement elements of the reinforced concrete pile, the second polygonal geometry being equivalent to the first polygonal geometry,
- each of the exposed part of the pile threaded bolt connectors having a first portion including a threaded portion, a second portion having a circular cross sectional configuration of a first outer diameter and a transition portion interconnecting the first portion and the second portion,
- a first interface being located between the first portion and the transition portion of each of the pile threaded bolt connectors at a first distance from the planar abutment surface,
- a second interface being located between the transition portion and the second portion of each of the pile threaded bolt connectors at a second distance from the planar abutment surface, the first distance being larger than the second distance,
- each of the gaskets having an annual shape forming a second inner diameter and second outer diameter,
- the tightening nuts having a first end surface, a second end surface and a central aperture including a tapered portion at the second surface end for providing a larger opening compared to the central aperture, the central aperture further including an internal threaded portion at the first end surface complimenting the threaded portion of the pile threaded bolt connectors,

- the second inner diameter of the gasket being congruent to the first outer diameter of each of the second portions of each the pile threaded bolt connectors and the second outer diameter being larger than the inner diameter of the internal threaded part of the tightening nuts,
- the tightening nuts being configured to be rotated relative to the threaded portion of the pile threaded bolt connectors for allowing the gaskets to be compressed towards the pile threaded bolt connectors, the inner tapered portion of the tightening nuts and the planar abutment surface for providing sealing relative to the pile threaded bolt connectors and the planar abutment surface.

[0008] The reinforced concrete pile is an elongated prefabricated concrete piles. The reinforced concrete pile is provided in various lengths.

[0009] The pile threaded bolt connectors would preferably be made from a stainless steel material, as the pile threaded bolt connectors are exposed to the environment and have to be able to withstand the weather. Stainless steel is the preferred material due to its corrosion resistance as stainless does not corrode or rust as ordinary steel (carbon steel) does. However, it is possible to use carbon steel for the steel reinforcement elements as the steel reinforcement element are embedded into the reinforcement concrete pile,

[0010] The gasket is preferably made from an elastomer material with a round cross-section and being designed to be compressed during assembly and would create a sealing at the interface between the plain unthreaded surface of the pile threaded bolt connectors and the planar abutment surface. Each gasket has an annual shape forming a second inner diameter being congruent to the first outer diameter of the pile threaded bolt connectors and second outer diameter being larger than the inner diameter of the internal threaded part of the tightening nut.

[0011] Each of the tightening nuts is configured to be rotated relative to the threaded portion of a pile threaded bolt connector and by rotating the tightening nut the tapered portion of the tightening nuts will be moved towards the gasket. Rotation of the tightening nut would cause the gasket to be compressed towards the outer surface of the pile threaded bolt connectors and the planar abutment surface and the compression of the gasket will provide a sealing between the pile threaded bolt connectors and the planar abutment surface.

[0012] In a further embodiment according to the first aspect, the transition portions having threaded portions being tapered over two revolutions from a fully threaded shaft to a plain unthreaded shaft. Through the use of pile threaded bolt connectors having a threaded portions being tapered over two revolutions from a fully threaded shaft to a plain unthreaded shaft, it is possible to obtain a sealing for preventing water to penetrate into the structure.

[0013] In a further embodiment according to the first aspect, the central aperture of the tightening nuts having an intermediate section having a second threaded section, the second threaded section extending between the tapered portion and the internal threaded portion, the second threaded section having a diameter being larger than the threaded diameter of the internal threaded portion. Through the use of tightening nuts having a second threaded section with a diameter being larger than the inner diameter of the internal threaded portion, it is possible for the tightening nut to be rotated beyond the threaded portion of the pile threaded bolt connectors. The second threaded section being an inner threaded section and the diameter of the second threaded section corresponds to the major diameter.

[0014] In a further embodiment according to the first aspect, wherein the internal threaded portion being tapered over two revolutions. Through the use of tightening nuts having internal threaded portion being tapered over two revolutions, it is possible to improve the sealing capability further and prevent penetration of water into the reinforced concrete pile.

[0015] In a further embodiment according to the first aspect, the second portions of the pile threaded bolt connectors being plain unthreaded portions. By using a pile threaded bolt connectors with a second portions having a plain unthreaded surface, it is possible to enhance the sealing capability at the interface between the outer surface of the gasket and the plain surface of the pile threaded bolt connectors. The plain contact surface improves the sealing capability compared to a threaded contact surface, hereby serving a first function. The plain unthreaded portion of the pile threaded bolt connectors will prevent, that the gasket from getting damaged or torn during tightening of tightening nuts during installation, where the overhead line mast is installed on top of the reinforced concrete pile, hereby serving a second function.

[0016] In a further embodiment according to the first aspect, the reinforcement elements including additional steel reinforcement elements extending in the circumference of the reinforced concrete. By using an additional steel reinforcement elements extending in the circumference, it is possible to obtain a steel mesh structure, which allows easier handling and positioning of the steel mesh structure during casting and fabrication of the reinforcement concrete pile. The of additional steel reinforcement elements forms a steel mesh or mesh cage together with the steel reinforcing bar.

[0017] The mesh cage or reinforcement cage consisted of two parts: longitudinal bars and transverse bars or spiral bar. The steel bar has vertical rib and transverse rib on surface for better application in concrete reinforcement and the steel bar is preferable made from cold drawn or hot drawn carbon steel wire rod, galvanized or mill black finish.

[0018] The longitudinal steel bars confines the core concrete, and the transverse steel bars or spiral bars fit around the longitudinal bars. The steel mesh cage provides reinforcement in the longitudinal and lateral strength to prevent cracking, and reduce the deflections occurrence probability.

[0019] The reinforcement cage has a polygonal geometry e.g. triangle or square and the reinforcement cages is

positioned in the casting mould before the concrete is poured the casting form. The steel reinforcement elements are spot welded to form a reinforcement cage, preferably by an automatic spot welding machine and the spot welding machine furthermore is able to program for being able to adjust the spacing and opening of the reinforcement cage.

[0020] In a further embodiment according to the first aspect, the reinforced concrete pile is a prefabricated structure. Through the use of a prefabricated reinforced concrete pile, it is faster to establish the foundation as the reinforced concrete does not need to casted in-situ and await the hardening of the concrete before the overhead line mast can be connected to the foundation.

[0021] In a further embodiment according to the first aspect, the second polygonal geometry and the first polygonal geometry being 3-12, preferably 4. By using a polygonal geometry it is optional, where the geometry should be rectangular, pentagonal, hexagonal etc.

[0022] In a further embodiment according to the first aspect, the reinforced concrete pile having visual markings on the outer surface for positioning the end part 0.1-1 meter above ground level, when the reinforced concrete pile is being driven into the ground. By using a visual markings on the reinforced concrete pile, the installation of the reinforced concrete pile can be done in a more precise manner, as the worker at the installation site can visual determine and inspect whether the reinforced concrete pile needs to be driven further into the ground.

[0023] In a further embodiment according to the first aspect, the pile threaded bolt connectors being connected to the steel reinforcement elements of the reinforced concrete pile by welding, preferably friction welding. By welding the each pile threaded bolt connectors to the steel reinforcement bars, the structural loads from the mast can be transferred from the pile threaded bolt connectors to the steel reinforcement elements embedded in the reinforced concrete pile.

[0024] The term pile foundation should in this context be understood as a prepared ground or base on which the overhead line mast, the power line mast or the like structure can be mounted. The pile foundation consists of an elongated structural element being driven or drilled into the deep of the ground and belong to the category also referred to as deep foundation.

[0025] The term deep foundation should in the context be understood as the type of foundation, which transfers load into the soil farther down from the ground level in contrast to shallow foundation, which primarily transfers loads from the structure to the surface layer at the vicinity of the ground level.

[0026] The term congruent is used in this context to describe a gasket being able to provide a tight fit relative to the outer diameter of the second portion of the pile threaded bolt connectors. Each gasket would have an inner diameter being identical to the outer diameter of the second portion of each of the pile threaded bolt connectors or an inner diameter substantial smaller than the outer diameter of the second portion of each of the pile threaded bolt connectors.

[0027] The term internal threaded portion is used in this context to describe an internal thread of the tightening nut is divided into two sections, which both have a major diameter and a minor diameter. The diameter of the internal threaded portion would in this context refer to the major diameter.

DETAILED DESCRIPTION

[0028] The invention will now be explained in more detail by means of examples of embodiments with reference to the schematic drawing.

Figure 1 shows a foundation installed along a railway track.

Figure 2 shows of a first and presently preferred embodiment of the reinforced concrete pile.

Figure 3 shows the steel reinforcement elements embedded inside the reinforced.

Figure 4A-4D shows the tightening of the tightening nut.

Figure 5A-5E shows a first and presently preferred embodiment of the pile threaded bolt connectors and a tightening nut.

Figure 6A-6D shows a second preferred embodiment of casting a reinforced concrete pile according to first embodiment of the invention.

Fig. 1 shows foundation 10 comprising a reinforced concrete pile 20 having threaded bolt connectors for allowing an overhead line mast 12 to be connected to the reinforced concrete pile 20 of the pile foundation.

[0029] The overhead power line 16 is suspended above the railway track 14 between the overhead line mast, supporting posts or arched catenary support or other carrying structures spaced along the railway track 14. The overhead power

line 16 is kept at a high electric potential for suppling electric power to the train. The reinforced concrete pile 20 penetrates the upper soil layers and will be embedded in the lower, more rigid lower soil layers. The reinforced concrete pile 20 is a precasted element and the reinforced concrete pile 20 is casted in a standardized length between 4 meter and 20 meter.

[0030] Fig. 2 and 3 show a reinforced concrete pile 20 having an elongated structure with a first end part 22 including a planar abutment surface of a first polygonal geometry and a second end part 26. Steel reinforcement elements 28 extends between the first end part 22 and the second end parts 28.

[0031] Four pile threaded bolt connectors 30 are embedded in the reinforced concrete pile 20 and each of pile threaded bolt connectors 30 has an exposed part extending beyond the first end part 22. The four pile threaded bolt connectors 30 are positioned in a second polygonal geometry and connected to the steel reinforcement elements 28 of the reinforced concrete pile 20.

[0032] The connection between each of the pile threaded bolt connectors 30 and the steel reinforcement elements 28 of the reinforced concrete pile 20 is obtained by welding process e.g. friction welding and the connection will be embedded inside the reinforced concrete pile 20.The pile threaded bolt connectors 30 would be made from a stainless steel material, as the pile threaded bolt connectors is exposed to the environment and have to be able to withstand the corrosion.

[0033] The steel reinforcement elements 28 are fabricated from an assembly of steel reinforcing bar 28', also commonly referred to as rebars, held together in the desired configuration by means of additional steel reinforcement elements 28" extending in the circumference of the reinforced concrete pile 20. The additional steel reinforcement elements 28" forms a steel mesh or mesh cage incorporation with the steel reinforcing bar 28'.

[0034] Two lifting sockets 29 are embedded into the reinforced concrete pile 20 and the lifting sockets 29 are placed at equal distance from the center of gravity of the reinforced concrete pile 20 for allowing as stable lifting of the reinforced concrete pile 20. Each of the lifting sockets 29 is connected to the steel reinforcement elements 28 by welding.

[0035] The lifting sockets 29 comprise an inner threaded portion and the threaded portion makes it possible for a worker to insert a swivel lifting eye into the lifting socket prior to lifting the reinforced concrete pile 20. The lifting socket could also be formed as tubular lifting socket, flat plate lifting socket or the like. Each of the lifting sockets 29 is covered by a sealing cap for preventing any foreign objects from entering the socket and the sealing cap fits inside the lifting socket 29.

[0036] The steel reinforcement elements 28 have the same polygonal geometry as the reinforced concrete pile 20 and the 28' steel reinforcing bars are placed along the circumference of the reinforced concrete pile 20 more specific near the edges of the polygonal geometry.

[0037] The second polygonal geometry is defined by the number of pile threaded bolt connectors embedded in the reinforced concrete pile 20 and the first polygonal geometry corresponds the outer geometry of the reinforced concrete pile 20. The first polygonal geometry is equivalent to the second polygonal geometry in fig. 2.

[0038] It is contemplated, that the tightening the tightening nut 501, 502, 503, 504 can be done in two steps, 'Initial Torque' and 'Final torque' using a calibrated torque wrench. This can be either a manual wrench or power tool fitted with a torque cut-out that must first be calibrated on a bolt from the job batch using a bolt load meter or similar device for determining bolt tension.

[0039] Fig. 4-5 show the pile threaded bolt connectors 30 having a first portion 32 including a threaded portion 33, a second portion 34 having a circular cross sectional configuration of a first outer diameter and a transition portion 38 interconnecting the first portion 32 and the second portion 32. The gaskets 40 having an annual shape forming a second inner diameter 42 and second outer diameter 44.

[0040] Fig. 4A shows a pile threaded bolt connectors 30 connected to the steel reinforcement elements 28 in the reinforced concrete pile 20. The second portion 34 of the pile threaded bolt connectors 30 has a circular cross sectional and the second portion 34 is connected to the steel reinforcing bar 28' by welding. The second portion 34 of the pile threaded bolt connectors 30 has a plain unthreaded portions. 6. The steel reinforcement elements 28 comprising of a number of steel reinforcing bars 28' and additional steel reinforcement elements 28" extending in the circumference of the reinforced concrete pile 20. The additional steel reinforcement elements 28" forms a steel mesh or mesh cage incorporation with the steel reinforcing bar 28'.

[0041] In fig. 4A-4D, the gasket 40 has a second inner diameter 42 being congruent to the first outer diameter of the second portions 36 of the pile threaded bolt connectors and the second outer diameter 44 is larger than the inner diameter of the internal threaded part of the tightening nuts 59.

[0042] In Fig. 4D, the first interface 60 is located between the first portion 32 and the transition portion 38 the pile threaded bolt connectors at a first distance d_1 from the planar abutment surface 24. The second interface 62 is located between the transition portion 38 and the second portion 34 of the pile threaded bolt connectors 30 at a second distance d_2 from the planar abutment surface 24

[0043] As indicated in fig. 4D, the first distance d_1 is larger than the second distance d_2 and the second distance d_2 is also larger the height h_g of the gasket. The height h_g of the gasket 40 corresponds to the thickness of the gasket 40. The second portion 34 of the pile threaded bolt connectors 30 has a plain unthreaded portion, which will prevent, that

the gasket 40 from getting damaged or torn during tightening of tightening nut 50 during installation of the mast on top of the reinforced concrete pile.

[0044] Fig. 4B-4D show the sequence of tightening the tightening nut 50, where the tightening nut is configured to be rotated relative to the threaded portion of the pile threaded bolt connectors .

[0045] Fig. 4B shows the tightening nut 50, where the tightening nut 50 does not exert any compression force on the gasket 40 and the gasket 40 is positioned around the plain unthreaded portion of the pile threaded bolt connectors 30 and abuts the planar abutment surface of the first end part 22.

[0046] Fig. 4C shows the tightening nut 50, where the tightening nut 50 is rotated further towards the planar abutment surface of the first end part 22. The tightening nut 50 begins to compress onto the gasket 40. The gasket 40 is positioned around the plain unthreaded portion of the pile threaded bolt connectors 30 and abuts the planar abutment surface of the first end part 22.

[0047] Fig. 4D shows a final position, where the tightening nut 50 is rotated relative to the threaded portion of the pile threaded bolt connectors 30 to the position, where the tightening nut 50 exerts the full compression load on the gasket. The amount of load on the gasket 40 causes the gasket to deform and the deformation of the gasket results in the gasket 40 being compressed towards the pile threaded bolt connectors, the inner tapered portion 55 of the tightening nuts and the planar abutment surface 24 for providing sealing relative to the pile threaded bolt connectors 30 and the planar abutment surface 24.

[0048] As shown in fig. 5B, the tightening nut 50 has an intermediate section including a second threaded section 56 and the second threaded section 56 extends between the tapered portion 55 and the internal threaded portion 58. The second threaded section 56 has a threaded diameter d_4 being larger than the threaded diameter d_3 of the internal threaded portion 58. By using a tightening nut 50 having an inner second threaded section 56 having a threaded diameter d_4 being larger than the inner diameter d_3 of the internal threaded portion, it is possible for the tightening nut 50 to be rotating beyond the threaded portion 33 of the pile threaded bolt connectors. The second threaded section being an inner threaded section and the threaded diameter corresponds to the major diameter of an internal thread.

[0049] As indicated in fig. 5B-5D, the tightening nut has first end surface 51, a second end surface 52 and a central aperture 54 including a tapered portion 55 at the second end surface 52 for providing a larger opening compared to the central aperture.

[0050] The central aperture 54 further includes a internal threaded portion 58 at the first end surface 54 complimenting the threaded portion 33 of the pile threaded bolt connectors 30.

[0051] Fig. 5D shows a first embodiment of the tightening nut 50 having a internal threaded portion being tapered over two revolutions.

[0052] Fig. 5C shows a first embodiment of the transition portions having threaded portions being tapered over two revolutions from a fully threaded shaft to a plain unthreaded shaft.

[0053] Fig. 6A-6D shows a second preferred embodiment of casting of the reinforced concrete pile. The method of casting a foundation, wherein the foundation comprising a reinforced concrete pile including pile threaded bolt connectors, a number of gaskets and a corresponding number of tightening nuts, comprising the step of:

- providing a casting mould 70 having two mould side walls 72, a first mould end part 74 including apertures 75, a second mould end part 76 and a bottom mould part 78,
- inserting a number of anti-adherent elements 80 made of a synthetic material, Teflon or the like into the apertures 75 of the first mould end part 74,
- placing corresponding gasket 40 and tightening nut 501, 502, 503, 504 to said pile threaded bold connectors 30 (not shown).
- placing steel reinforcement elements into the casting mould, the steel reinforcement elements extending between the first end part and the second end parts of the casting mould and a number of pile threaded bolt connectors being connected to the steel reinforcement elements and allowing the pile threaded bolt connectors to extend beyond the first mould end part,
- pouring concrete into the casting mould.
- casting a reinforced concrete pile defining an elongated structure having a first end part including a planar abutment surface of a first polygonal geometry and a second end part, steel reinforcement elements extending between the first end part and the second end parts, the pile threaded bolt connectors being embedded in the reinforced concrete pile and each having an exposed part extending beyond the first end part and positioned in a second polygonal geometry and connected to the steel reinforcement elements of the reinforced concrete pile, the second polygonal geometry being equivalent to the first polygonal geometry.

[0054] By using a number of anti-adherent elements 80 made of a synthetic material, Teflon or the like into the apertures 75 of the first mould end part 74, it is possible to establish a reinforced concrete pile having a smooth planar abutment surface. By having a smooth planar abutment surface, the sealing capability is enhanced and the smooth surface of first

end part 22 prevent water from gathering in void created in an otherwise uneven first end part 22.

[0055] In figure 6A-6D, the four pile threaded bolt connectors 30 are placed in the casting mould 70 and each of pile threaded bolt connectors 30 has an exposed part extending into the apertures 75 of the first mould end part 74 and beyond the first end part 22.

[0056] The steel reinforcement elements 28 consists of steel bars 28' 28" forming a steel reinforcement cage 28'" fabricated from an assembly of longitudinal steel reinforcing bar 28' and transverse steel reinforcement bar 28" extending in the circumference of the reinforced concrete pile 20. The four pile threaded bolt connectors 30 are positioned in a second polygonal geometry and connected to the steel reinforcement bars 28' of the steel reinforcement cage. The steel reinforcement cage 28'" forms a recgtangular polygonal geometry.

[0057] Two lifting sockets 29 are placed at equal distance in the casting mould 70 and the lifting sockets 29 is connected to the steel reinforcement elements 28 by welding.

[0058] The lifting socket 29 comprises an inner threaded portion and the threaded portion makes it possible for a worker to insert a swivel lifting eye into the lifting socket prior to lifting the casted reinforced concrete pile 20 out of the casting mould 70.

[0059] The casting mould 70 is used for casting reinforced concrete pile 20 having an elongated structure with a first end part 22 including a planar abutment surface of a first polygonal geometry and a second end part 26.

[0060] The reinforced concrete piles are preferably precasted concrete elements manufactured in at a larger manufacturing facility and delivered, ready to use, to the installation site. Pre-casted reinforced concrete piles can also be fabricated on site and tilted or lifted into position.

[0061] Fig 6A shows the step of placing the steel reinforcement cage 28'" into the casting mould 70 and steel reinforcement cage 28" comprising of a number of steel reinforcing bars 28' and additional steel reinforcement elements 28" extending in the circumference of the steel reinforcement cage 28"'.

[0062] The inserts 80 is made of anti-adherent synthetic material, without or with a built-in supporting body, made of metal or synthetic material.

[0063] The method further comprising the step of:

- arranging the pile threaded bolt connectors in the casting mould for providing a reinforced concrete pile having a first interface being located between the first portion and the transition portion of each of the pile threaded bolt connectors at a first distance from the planar abutment surface, and a second interface being located between the transition portion and the second portion of each of the pile threaded bolt connectors at a second distance from the planar abutment surface, the first distance being larger than the second distance.

REFERENCE NUMBERS

[0064]

10	foundation
12	mast
14	railway track
16	overhead line, power line mast or the like,
18	support structure
20	reinforced concrete pile
22	first end part
24	planar abutment surface
26	second end part,
28	steel reinforcement elements
28'	steel reinforcing bar
28"	additional steel reinforcement elements steel reinforcement cage 28'"
29	lifting socket
30	pile threaded bolt connectors
31	exposed part
32	first portion,
33	threaded portion
34	second portion
36	first outer diameter of the second portion
38	transition portion
40	gaskets
42	second inner diameter

44	second outer diameter
50	tightening nut
501, 502, 503, 504	tightening nuts
51	first end surface
52	second end surface
54	central aperture
55	tapered portion
56	second threaded section
57	intermediate section
58	internal threaded portion
59	inner diameter of the internal threaded
60	first interface
62	second interface
d_1	first distance
d_2	second distance
d_3	diameter, third distance
d_4	diameter, fourth distance
h_g	height of the gasket
70	casting mould
72	mould side wall
73	mould side wall
74	first mould end part
75	apertures
76	second mould end part
78	bottom mould part
80	anti-adherent element

Claims

1. A foundation (10) for an overhead line mast, power line mast (12) or the like, comprising a reinforced concrete pile (20) including pile threaded bolt connectors (30):

- said reinforced concrete pile (20) defining an elongated structure having a first end part (22) including a planar abutment surface (24) of a first polygonal geometry and a second end part (26), steel reinforcement elements (28) extending between said first end part (22) and said second end part (26), said pile threaded bolt connectors (30) being embedded in said reinforced concrete (20) pile and each having an exposed part extending beyond said first end part (22) and positioned in a second polygonal geometry and connected to said steel reinforcement elements (28) of said reinforced concrete pile (20), said second polygonal geometry being equivalent to said first polygonal geometry, **characterized in** said foundation further comprising a number of gaskets (40) and a corresponding number of tightening nuts (501), (502), (503), (504);
- each of said exposed parts of said pile threaded bolt connectors (30) having a first portion (32) including a threaded portion (33), a second portion (34) having a circular cross sectional configuration of a first outer diameter (36) and a transition portion (38) interconnecting said first portion (32) and said second portion (34),
- a first interface (60) being located between said first portion (32) and said transition portion (38) of each of said pile threaded bolt connectors (30) at a first distance (d1) from said planar abutment surface (24),
- a second interface (62) being located between said transition portion (38) and said second portion (34) of each of said pile threaded bolt connectors (30) at a second distance (d2) from said planar abutment surface (24), said first distance d1 being larger than said second distance (d2),
- each of said gaskets (40) having an annual shape defining a second inner diameter (42) and second outer diameter (44),
- said tightening nuts (501), (502), (503), (504) having a first end surface (51), a second end surface and a central aperture (54) including a tapered portion (55) at said second surface (52) end for providing a larger opening compared to said central aperture (54), said central aperture (54) further including an internal threaded portion at said first end surface (51) complimenting said threaded portion (33) of said pile threaded bolt connectors (30),
- said second inner diameter (42) of said gasket (40) being congruent to said first outer diameter (44) of each of said second portions (34) of each of said pile threaded bolt connectors 30 and said second outer diameter

(44) being larger than said inner diameter (59) of said internal threaded part of said tightening nuts (501), (502), (503), (504),

- said tightening nuts (501), (502), (503), (504) being configured to be rotated relative to said threaded portion (33) of said pile threaded bolt connectors (30) for allowing said gaskets (40) to be compressed towards said pile threaded bolt connectors (30), said tapered portion (55) of said tightening nuts (501), (502), (503), (504) and said planar abutment surface (24) for providing sealing relative to said pile threaded bolt connectors (30) and said planar abutment surface (24).

2. A foundation (10) according to claim 1, wherein said transition portions (38) having threaded portions being tapered over two revolutions from a fully threaded shaft to a plain unthreaded shaft.

3. A foundation (10) according to any of the preceding claims, said central aperture (54) of said tightening nuts (501), (502), (503), (504) having an intermediate section having a second threaded section, said second threaded section extending between said tapered portion (55) and said internal threaded portion, said second threaded section having a diameter being larger than the thread angle of the said internal threaded portion.

4. A foundation (10) according to claim 1, wherein said internal threaded portion being tapered over two revolutions.

5. A foundation (10) according to any of the preceding claims, wherein said second portions (34) of said pile threaded bolt connectors (30) being plain unthreaded portions.

6. A foundation (10) according to any of the preceding claims, wherein said reinforcement elements including additional steel reinforcement elements (28) extending in the circumference of said reinforced concrete pile (20).

7. A foundation (10) according to any of the preceding claims, wherein said reinforced concrete pile (20) is a prefabricated structure.

8. A foundation (10) according to any of the preceding claims, wherein said second polygonal geometry and said first polygonal geometry being 3-12, preferably 4.

9. A foundation (10) according to any of the preceding claims, wherein said reinforced concrete pile (20) having visual markings on the outer surface for positioning said first end part (22) 0,1-1 meter above ground level, when said reinforced concrete pile (20) is being driven into the ground.

10. A foundation (10) according to any of the preceding claims, wherein said pile threaded bolt connectors (30) being connected to said steel reinforcement elements (28) of said reinforced concrete pile (20) by welding, preferably friction welding.

11. A method of establishing a foundation (10) for an overhead line mast (12), power line mast or the like, comprising a reinforced concrete pile including pile threaded bolt connectors (30):

- providing said reinforced concrete pile (20) defining an elongated structure having a first end part (22) including a planar abutment surface (24) of a first polygonal geometry and a second end part (26), steel reinforcement elements (28) extending between said first end part (22) and said second end part (26), said pile threaded bolt connectors (30) being embedded in said reinforced concrete pile (20) and each having an exposed part extending beyond said first end part (22) and positioned in a second polygonal geometry and connected to said steel reinforcement elements (28) of said reinforced concrete pile (20), said second polygonal geometry being equivalent to said first polygonal geometry, **characterized in** said foundation further comprising a number of gaskets (40) and a corresponding number of tightening nuts (501), (502), (503), (504):
- providing each of said exposed part of said pile threaded bolt connectors (30) having a first portion (32) including a threaded portion, a second portion (34) having a circular cross sectional configuration of a first outer diameter (36) and a transition portion (38) interconnecting said first portion (32) and said second portion (34),
- providing a first interface (60) being located between said first portion (32) and said transition portion (38) of each of said pile threaded bolt connectors (30) at a first distance d1 from said planar abutment surface (24),
- providing a second interface (62) being located between said transition portion (38) and said second portion (34) of each of said pile threaded bolt connectors (30) at a second distance (d2) from said planar abutment surface (24), said first distance (d1) being larger than said second distance (d2),
- each of said gaskets (40) having an annual shape forming a second inner diameter (42) and second outer

diameter (44),
- providing said tightening nuts (501), (502), (503), (504) having a first end surface (51), a second end surface (52) and a central aperture including a tapered (55) portion at said second surface (52) end for providing a larger opening compared to said central aperture (54), said central aperture (54) further including an internal threaded portion at said first end surface (51) complimenting said threaded portion of said pile threaded bolt connectors (30),
- said second inner diameter (42) of said gasket (40) being congruent to said first outer diameter (44) of each of said second portions (34) of each said pile threaded bolt connectors (30) and said second outer diameter (44) being larger than the inner diameter (36) of said internal threaded part of said tightening nuts (501), (502), (503), (504),
- rotating said tightening nuts (501), (502), (503), (504) relative to said threaded portion of said pile threaded bolt connectors (30), compressing said gaskets (40) towards said pile threaded bolt connectors (30), said inner tapered portion (55) of said tightening nuts and said planar abutment surface (24) and establishing sealing relative to said pile threaded bolt connectors (30) and said planar abutment surface (24).

12. A method of establishing a foundation (10) according to claim 11 further rotating said tightening nuts (501), (502), (503), (504) in a predetermined tightening sequence providing a preloaded connecting between said reinforced concrete pile (20) and the overhead line mast (12), power line mast or the like.

13. A method of casting a foundation (10) as claimed in any of claims 1-10, wherein said method comprises the steps of:

- providing a casting mould having two mould side walls, a first mould end part (74) including apertures (75), a second mould end part (76) and a bottom mould part,
- inserting a number of anti-adherent elements made of a synthetic material, Teflon or the like into the apertures (75) of the first mould end part (74),
- placing steel reinforcement elements (28) into the casting mould and said steel reinforcement elements (28) extending between said first end part (22) and said second end part (26) of the casting mould, a number of pile threaded bolt connectors (30) being connected to said steel reinforcement elements (28) and allowing said pile threaded bolt connectors (30) to extend beyond said first mould end part (74),
- placing corresponding gasket (40) and tightening nut (501), (502), (503), (504) to said pile threaded bold connectors (30),
- pouring concrete into the casting mould.
- casting a reinforced concrete pile (20) defining an elongated structure having a first end part (22) including a planar abutment surface (24) of a first polygonal geometry and a second end part (24), steel reinforcement elements (28) extending between said first end part (22) and said second end part (24), said pile threaded bolt connectors (30) being embedded in said reinforced concrete pile (20) and each having an exposed part extending beyond said first end part (22) and positioned in a second polygonal geometry and connected to said steel reinforcement elements (28) of said reinforced concrete pile (20), said second polygonal geometry being equivalent to said first polygonal geometry.

14. A method of casting a foundation (10) according to claim 13, wherein said method further comprising the step of:

- arranging said pile threaded bolt connectors (30) in the casting mould for providing a reinforced concrete pile (20) having a first interface (60) being located between said first portion (32) and said transition portion (38) of each of said pile threaded bolt connectors (30) at a first distance (d1) from said planar abutment surface (24), and a second interface (62) being located between said transition portion and said second portion (34) of each of said pile threaded bolt connectors (30) at a second distance (d2) from said planar abutment surface (24), said first distance (d1) being larger than said second distance (d2).

Patentansprüche

1. Fundament (10) für einen Freileitungsmast, Stromleitungsmast (12) oder dergleichen, umfassend einen Stahlbetonpfahl (20) mit Pfahlgewindebolzenverbinder (30):

- wobei der Stahlbetonpfahl (20) eine langgestreckte Struktur mit einem ersten Endteil (22) mit einer ebenen Anlagefläche (24) einer ersten polygonalen Geometrie und einem zweiten Endteil (26) definiert, wobei Stahlverstärkungselemente (28) sich zwischen dem ersten Endteil (22) und dem zweiten Endteil (26) erstrecken,

wobei die Pfahlgewindebolzenverbinder (30) in den Stahlbetonpfahl (20) eingebettet sind und jeweils einen freiliegenden Teil aufweisen, der sich über den ersten Endteil (22) hinaus erstreckt, und in einer zweiten polygonalen Geometrie positioniert und mit den Stahlverstärkungselementen (28) des Stahlbetonpfahls (20) verbunden sind, wobei die zweite polygonale Geometrie der ersten polygonalen Geometrie äquivalent ist,
dadurch gekennzeichnet, dass das Fundament ferner eine Anzahl von Dichtungen (40) und eine entsprechende Anzahl von Spannmuttern (501), (502), (503), (504) umfasst;
- jeder der freiliegenden Teile der Pfahlgewindebolzenverbinder (30) umfasst: einen ersten Abschnitt (32) mit einem Gewindeabschnitt (33); einen zweiten Abschnitt (34) mit einer kreisförmigen Querschnittskonfiguration eines ersten Außendurchmessers (36); und einen Übergangsabschnitt (38), der den ersten Abschnitt (32) und den zweiten Abschnitt (34) verbindet,
- wobei eine erste Schnittstelle (60), die sich zwischen dem ersten Abschnitt (32) und dem Übergangsabschnitt (38) jedes der Pfahlgewindebolzenverbinder (30) in einem ersten Abstand (d1) von der ebenen Anlagefläche (24) befindet,
- wobei eine zweite Schnittstelle (62), die sich zwischen dem Übergangsabschnitt (38) und dem zweiten Abschnitt (34) jedes der Pfahlgewindebolzenverbinder (30) in einem zweiten Abstand (d2) von der ebenen Anlagefläche (24) befindet, wobei der erste Abstand (d1) größer als der zweite Abstand (d2) ist,
- wobei jede der Dichtungen (40) eine Kreisform hat, die einen zweiten Innendurchmesser (42) und einen zweiten Außendurchmesser (44) definiert,
- wobei die Spannmuttern (501), (502), (503), (504) umfassen: eine erste Endfläche (51), eine zweite Endfläche und eine zentrale Öffnung (54) mit einem konischen Abschnitt (55) an der zweiten Endfläche (52) zum Bereitstellen einer größeren Öffnung im Vergleich zu der zentralen Öffnung (54), wobei die zentrale Öffnung (54) ferner einen Innengewindeabschnitt an der ersten Endfläche (51) umfasst, der den Gewindeabschnitt (33) des Pfahlgewindebolzenverbinder (30) ergänzt,
- wobei der zweite Innendurchmesser (42) der Dichtung (40) kongruent, mit dem ersten Außendurchmesser (44) jedes der zweiten Abschnitte (34) jedes der Pfahl-gewindebolzenverbinder (30) ist und wobei der zweiten Außendurchmesser (44) größer als der Innendurchmesser (59) des Innengewindeteils der Spannmuttern (501), (502), (503), (504) ist,
- wobei die Spannmuttern (501), (502), (503), (504) so konfiguriert sind, dass sie relativ zu dem Gewindeabschnitt (33) der Pfahlgewindebolzenverbinder (30) gedreht werden, um zu ermöglichen, dass die Dichtungen (40) gegen die Pfahlgewindebolzen (30), den konischen Abschnitt (55) der Spannmuttern (501), (502), (503), (504) und die ebene Anlagefläche (24) zusammengedrückt sind, um eine Abdichtung gegenüber dem bereitzustellen Pfahlgewindebolzenverbinder (30) und der ebenen Anlagefläche (24) bereitzustellen.

2. Fundament (10) nach Anspruch 1, wobei die Übergangsabschnitte (38) Gewindeabschnitte aufweisen, die sich über zwei Umdrehungen von einer Welle mit Vollgewinde zu einer ebenen Welle ohne Gewinde verjüngen.

3. Fundament (10) nach einem der vorhergehenden Ansprüche, wobei die zentrale Öffnung (54) der Spannmuttern (501), (502), (503), (504) einen Zwischenabschnitt mit einem zweiten Gewindeabschnitt aufweist, wobei sich der zweite Gewindeabschnitt zwischen dem konischen Abschnitt (55) und dem Innengewindeabschnitt erstreckt, wobei der zweite Gewindeabschnitt einen Durchmesser hat, der größer als der Gewindewinkel des Innengewindeabschnitts ist.

4. Fundament (10) nach Anspruch 1, wobei der Innengewindeabschnitt sich über zwei Umdrehungen verjüngt.

5. Fundament (10) nach einem der vorhergehenden Ansprüche, wobei die zweiten Abschnitte (34) der Pfahlgewindebolzenverbinder (30) einfache Abschnitte ohne Gewinde sind.

6. Fundament (10) nach einem der vorhergehenden Ansprüche, wobei die Bewehrungselemente zusätzliche Stahlbewehrungselemente (28) umfassen, die sich im Umfang des Stahlbetonpfahls (20) erstrecken.

7. Fundament (10) nach einem der vorhergehenden Ansprüche, wobei der Stahlbetonpfahl (20) eine vorgefertigte Struktur ist.

8. Fundament (10) nach einem der vorhergehenden Ansprüche, wobei die zweite polygonale Geometrie und die erste polygonale Geometrie 3-12, vorzugsweise 4 betragen.

9. Fundament (10) nach einem der vorhergehenden Ansprüche, wobei der Stahlbetonpfahl (20) auf der Außenfläche sichtbare Markierungen zum Positionieren des ersten Endteils (22) 0,1-1 Meter über dem Bodenniveau aufweist,

wenn der Stahlbetonpfahl (20) in den Boden gerammt wird.

10. Fundament (10) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Pfahlgewindebolzen (30) mit den Stahlbewehrungselementen (28) des Stahlbetonpfahls (20) durch Schweißen, vorzugsweise Reibschweißen, verbunden sind.

11. Verfahren zum Herstellen eines Fundaments (10) für einen Freileitungsmast (12), Stromleitungsmast oder dergleichen, umfassend einen Stahlbetonpfahl mit Pfahlgewindebolzenverbindern (30):

- Bereitstellen des Stahlbetonpfahls (20), der eine längliche Struktur mit einem ersten Endteil (22) mit einer ebenen Anlagefläche (24) einer ersten polygonalen Geometrie und einem zweiten Endteil (26) definiert, wobei sich Stahlverstärkungselemente (28) zwischen dem ersten Endteil (22) und dem zweiten Endteil (26) erstrecken, wobei die Pfahlgewindebolzenverbinder (30) in den Stahlbetonpfahl (20) eingebettet sind und jeweils einen freiliegenden Teil aufweisen, der sich über den ersten Endteil (22) hinaus erstreckt und in einer zweiten polygonalen Geometrie positioniert und mit den Stahlverstärkungselementen (28) des Stahlbetonpfahls (20) verbunden sind, wobei die zweite polygonale Geometrie der ersten polygonalen Geometrie äquivalent ist,
dadurch gekennzeichnet, dass das Fundament ferner eine Anzahl von Dichtungen (40) und eine entsprechende Anzahl von Spannmuttern (501), (502), (503), (504) umfasst;
- Bereitstellen jedes der exponierten Teile der Pfahlgewindebolzenverbinder (30) mit einem ersten Abschnitt (32), der einen Gewindeabschnitt enthält, einem zweiten Abschnitt (34) mit einer kreisförmigen Querschnittskonfiguration eines ersten Außendurchmessers (36) und einem Übergangsabschnitt (38), der den ersten Abschnitt (32) und den zweiten Abschnitt (34) verbindet,
- Bereitstellen einer ersten Schnittstelle (60), die sich zwischen dem ersten Abschnitt (32) und dem Übergangsabschnitt (38) jedes der Pfahlgewindebolzenverbinder (30) in einem ersten Abstand (d1) von der ebenen Anlagefläche (24) befindet,
- Bereitstellen einer zweiten Schnittstelle (62), die sich zwischen dem Übergangsabschnitt (38) und dem zweiten Abschnitt (34) jedes der Pfahlgewindebolzenverbinder (30) in einem zweiten Abstand (d2) von der ebenen Anlagefläche (24) befindet, wobei der erste Abstand (d1) größer ist als der zweite Abstand (d2) ist,
- wobei jede der Dichtungen (40) eine Kreisform hat, die einen zweiten Innendurchmesser (42) und einen zweiten Außendurchmesser (44) bildet,
- Bereitstellen der Spannmuttern (501), (502), (503), (504) mit einer ersten Endfläche (51), einer zweiten Endfläche (52) und einer zentralen Öffnung, die einen sich verjüngenden (55) Abschnitt an dem zweiten Oberflächenende (52) aufweist, zum Bereitstellen einer größeren Öffnung im Vergleich zu der zentralen Öffnung (54), wobei die zentrale Öffnung (54) ferner einen Innengewindeabschnitt an der ersten Endfläche (51), der den Gewindeabschnitt der Pfahl-gewindebolzenverbinder (30) ergänzt, umfasst,
- wobei der zweite Innendurchmesser (42) der Dichtung (40) mit dem ersten Außendurchmesser (44) jedes der zweiten Abschnitte (34) jedes der Pfahlgewindebolzenverbinder (30) kongruent ist, und wobei der zweite Außendurchmesser (44) größer als der Innendurchmesser (36) des Innengewindeteils der Spannmuttern (501), (502), (503), (504) ist,
- Drehen der Spannmuttern (501), (502), (503), (504) relativ zu dem Gewindeabschnitt der Pfahlgewindebolzenverbinder (30), Zusammendrücken der Dichtungen (40) in Richtung der Pfahlgewindebolzenverbinder (30), wobei der innere sich verjüngende Abschnitt (55) der Spannmuttern und der ebenen Anlagefläche (24) eine Abdichtung relativ zu den Pfahlgewindebolzenverbindern (30) und der ebenen Anlagefläche (24) herstellt.

12. Verfahren zum Einrichten eines Fundaments (10) nach Anspruch 11, wobei ferner die Spannmuttern (501), (502), (503), (504) in einer vorbestimmten Spannsequenz gedreht werden, um eine vorgespannte Verbindung zwischen den Stahlbetonpfählen (20) und dem Freileitungsmast (12), dem Stromleitungsmast oder dergleichen bereitzustellen.

13. Verfahren zum Gießen eines Fundaments (10) nach einem der Ansprüche 1 bis 10, wobei das Verfahren die Schritte umfasst:

- Bereitstellen einer Gießform mit zwei Formseitenwänden, einem ersten Formendteil (74) mit Öffnungen (75), einem zweiten Formendteil (76) und einem unteren Formteil,
- Einsetzen mehrerer Antihaftelemente aus Kunststoff, Teflon oder dergleichen in die Öffnungen (75) des ersten Formendteils (74),
- Einbringen von Stahlverstärkungselementen (28) in die Gießform und der sich zwischen dem ersten Endteil (22) und dem zweiten Endteil (26) der Gießform erstreckenden Stahlverstärkungselemente (28), wobei einer

Anzahl von pfahlprofilierten Bolzenverbindern (30) mit den Stahlverstärkungselementen (28) verbunden ist und es den mit Pfahlgewinden versehenen Bolzenverbindern (30) ermöglicht, sich über das erste Formendteil (74) hinaus zu erstrecken,
- Anordnen der entsprechenden Dichtung (40) und Festziehen der Spannmuttern (501), (502), (503), (504) an den schraubenförmigen Pfahlgewindeverbindern (30),
- Beton in die Gießform gießen,
- Gießen eines Stahlbetonpfahls (20), der eine langgestreckte Struktur mit einem ersten Endteil (22) mit einer ebenen Anschlagfläche (24) einer ersten polygonalen Geometrie und einem zweiten Endteil (24) definiert, wobei sich Stahlverstärkungselemente (28) zwischen dem ersten Endteil (22) und dem zweiten Endteil (24) erstrecken, wobei die Pfahlgewindebolzenverbinder (30) in den Stahlbetonpfahl (20) eingebettet sind und jeweils einen freiliegenden Teil aufweisen, der sich über den ersten Endteil (22) hinaus erstreckt und in einer zweiten polygonalen Geometrie positioniert und mit den Stahlverstärkungselementen (28) des Stahlbetonpfahls (20) verbunden ist, wobei die zweite polygonale Geometrie der ersten polygonalen Geometrie äquivalent ist.

14. Verfahren zum Gießen eines Fundaments (10) nach Anspruch 13, wobei das Verfahren ferner den Schritt umfasst:

- Anordnen der Pfahl-Gewindebolzenverbinder (30) in der Gießform, um einen Stahlbetonpfahl (20) mit einer ersten Grenzfläche (60) bereitzustellen, die zwischen dem ersten Abschnitt (32) und dem Übergangsabschnitt (38) jedes der Pfahlgewindebolzenverbinder (30) in einem ersten Abstand (d1) von der ebenen Anlagefläche (24) angeordnet ist, und eine zweite Schnittstelle (62), die zwischen dem Übergangsabschnitt und dem zweiten Abschnitt (34) jedes der Pfahlgewindebolzenverbinder (30) in einem zweiten Abstand (d2) von der ebenen Anlagefläche (24) angeordnet ist, wobei der erste Abstand (d1) größer als der zweite Abstand (d2) ist.

Revendications

1. Fondation (10) pour un mât de ligne aérienne, un mât de ligne électrique (12) ou similaire, comprenant un pieu en béton armé (20) incluant des connecteurs de pieu à boulon fileté (30) :

- ledit pieu en béton armé (20) définissant une structure allongée ayant une première partie d'extrémité (22) incluant une surface d'appui planaire (24) d'une première géométrie polygonale et une deuxième partie d'extrémité (26), des éléments de renforcement en acier (28) s'étendant entre ladite première partie d'extrémité (22) et ladite deuxième partie d'extrémité (26), lesdits connecteurs de pieu à boulon fileté (30) étant incorporés dans ledit pieu en béton armé (20) et ayant chacun une partie exposée s'étendant au-delà de ladite première partie d'extrémité (22) et positionnés dans une deuxième géométrie polygonale et reliés auxdits éléments de renforcement en acier (28) dudit pieu en béton armé (20), ladite deuxième géométrie polygonale étant équivalente à ladite première géométrie polygonale, **caractérisée en ce que** ladite fondation comprend en outre un certain nombre de joints (40) et un nombre correspondant d'écrous de serrage (501), (502), (503), (504) ;

  - chacune desdites parties exposées desdits connecteurs de pieu à boulon fileté (30) ayant une première portion (32) incluant une portion filetée (33), une deuxième portion (34) ayant une configuration de section transversale circulaire d'un premier diamètre extérieur (36) et une portion de transition (38) interconnectant ladite première portion (32) et ladite deuxième portion (34),
  - une première interface (60) étant située entre ladite première portion (32) et ladite portion de transition (38) de chacun desdits connecteurs de pieu à boulon fileté (30) à une première distance (d1) de ladite surface d'appui planaire (24),
  - une deuxième interface (62) étant située entre ladite portion de transition (38) et ladite deuxième portion (34) de chacun desdits connecteurs de pieu à boulon fileté (30) à une deuxième distance (d2) de ladite surface d'appui planaire (24), ladite première distance d1 étant supérieure à ladite deuxième distance (d2),
  - chacun desdits joints (40) ayant une forme annulaire définissant un deuxième diamètre intérieur (42) et un deuxième diamètre extérieur (44),
  - lesdits écrous de serrage (501), (502), (503), (504) ayant une première surface d'extrémité (51), une deuxième surface d'extrémité et un orifice central (54) incluant une portion effilée (55) au niveau de ladite deuxième extrémité de surface (52) pour fournir une ouverture supérieure par rapport audit orifice central (54), ledit orifice central (54) incluant en outre une portion intérieure filetée au niveau de ladite première surface d'extrémité (51) complémentant ladite portion filetée (33) desdits connecteurs de pieu à boulon fileté (30),
  - ledit deuxième diamètre intérieur (42) dudit joint (40) étant congruent audit premier diamètre extérieur

(44) de chacune desdites deuxièmes portions (34) de chacun desdits connecteurs de pieu à boulon fileté 30 et ledit deuxième diamètre extérieur (44) étant supérieur audit diamètre intérieur (59) de ladite partie intérieure filetée desdits écrous de serrage (501), (502), (503), (504),
- lesdits écrous de serrage (501), (502), (503), (504) étant configurés pour être tournés par rapport à ladite portion filetée (33) desdits connecteurs de pieu à boulon fileté (30) pour permettre auxdits joints (40) d'être compressés vers lesdits connecteurs de pieu à boulon fileté (30), ladite portion effilée (55) desdits écrous de serrage (501), (502), (503), (504) et ladite surface d'appui planaire (24) pour fournir un scellement par rapport auxdits connecteurs de pieu à boulon fileté (30) et ladite surface d'appui planaire (24).

2. Fondation (10) selon la revendication 1, dans laquelle lesdites portions de transition (38) ayant des portions filetées étant effilées sur deux révolutions d'un arbre complètement fileté à un arbre lisse non fileté.

3. Fondation (10) selon l'une quelconque des revendications précédentes, ledit orifice central (54) desdits écrous de serrage (501), (502), (503), (504) ayant une section intermédiaire ayant une deuxième section filetée, ladite deuxième section filetée s'étendant entre ladite portion effilée (55) et ladite portion intérieure filetée, ladite deuxième section filetée ayant un diamètre étant supérieur à l'angle de filetage de ladite portion intérieure filetée.

4. Fondation (10) selon la revendication 1, dans laquelle ladite portion intérieure filetée étant effilée sur deux révolutions.

5. Fondation (10) selon l'une quelconque des revendications précédentes, dans laquelle lesdites deuxièmes portions (34) desdits connecteurs de pieu à boulon fileté (30) étant des portions lisses non filetées.

6. Fondation (10) selon l'une quelconque des revendications précédentes, dans laquelle lesdits éléments de renforcement incluant des éléments de renforcement en acier (28) supplémentaires s'étendant sur la circonférence dudit pieu en béton armé (20).

7. Fondation (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit pieu en béton armé (20) est une structure préfabriquée.

8. Fondation (10) selon l'une quelconque des revendications précédentes, dans laquelle ladite deuxième géométrie polygonale et ladite première géométrie polygonale étant 3-12, de préférence 4.

9. Fondation (10) selon l'une quelconque des revendications précédentes, dans laquelle ledit pieu en béton armé (20) ayant des marquages visuels sur la surface extérieure pour positionner ladite première partie d'extrémité (22) 0,1-1 mètres au-dessus du sol, lorsque ledit pieu en béton armé (20) est enfoncé dans le sol.

10. Fondation (10) selon l'une quelconque des revendications précédentes, dans laquelle lesdits connecteurs de pieu à boulon fileté (30) étant reliés auxdits éléments de renforcement en acier (28) dudit pieu en béton armé (20) par soudage, de préférence soudage par friction.

11. Procédé d'établissement d'une fondation (10) pour un mât de ligne aérienne (12), un mât de ligne électrique ou similaire, comprenant un pieu en béton armé incluant des connecteurs de pieu à boulon fileté (30) :

- fournir ledit pieu de béton armé (20) définissant une structure allongée ayant une première partie d'extrémité (22) incluant une surface d'appui planaire (24) d'une première géométrie polygonale et une deuxième partie d'extrémité (26), des éléments de renforcement en acier (28) s'étendant entre ladite première partie d'extrémité (22) et ladite deuxième partie d'extrémité (26), lesdits connecteurs de pieu à boulon fileté (30) étant incorporés dans ledit pieu en béton armé (20) et ayant chacun une partie exposée s'étendant au-delà de ladite première partie d'extrémité (22) et positionnés dans une deuxième géométrie polygonale et reliés auxdits éléments de renforcement en acier (28) dudit pieu en béton armé (20), ladite deuxième géométrie polygonale étant équivalente à ladite première géométrie polygonale, **caractérisée en ce que** ladite fondation comprend en outre un certain nombre de joints (40) et un nombre correspondant d'écrous de serrage (501), (502), (503), (504) :
- fournir chacune de ladite partie exposée desdits connecteurs de pieu à boulon fileté (30) ayant une première portion (32) incluant une portion filetée, une deuxième portion (34) ayant une configuration de section transversale circulaire d'un premier diamètre extérieur (36) et une portion de transition (38) interconnectant ladite première portion (32) et ladite deuxième portion (34),
- fournir une première interface (60) étant située entre ladite première portion (32) et ladite portion de transition (38) de chacun desdits connecteurs de pieu à boulon fileté (30) à une première distance d1 de ladite surface

d'appui planaire (24),
- fournir une deuxième interface (62) étant située entre ladite portion de transition (38) et ladite deuxième portion (34) de chacun desdits connecteurs de pieu à boulon fileté (30) à une deuxième distance (d2) de ladite surface d'appui planaire (24), ladite première distance (d1) étant supérieure à ladite deuxième distance (d2), chacun desdits joints (40) ayant une forme annulaire formant un deuxième diamètre intérieur (42) et un deuxième diamètre extérieur (44),
- fournir lesdits écrous de serrage (501), (502), (503), (504) ayant une première surface d'extrémité (51), une deuxième surface d'extrémité (52) et un orifice central incluant une portion effilée (55) au niveau de ladite deuxième extrémité de surface (52) pour fournir une ouverture supérieure par rapport audit orifice central (54), ledit orifice central (54) incluant en outre une portion intérieure filetée au niveau de ladite première surface d'extrémité (51) complémentant ladite portion filetée desdits connecteurs de pieu à boulon fileté (30),
- ledit deuxième diamètre intérieur (42) dudit joint (40) étant congruent audit premier diamètre extérieur (44) de chacune desdites deuxièmes portions (34) de chacun desdits connecteurs de pieu à boulon fileté (30) et ledit deuxième diamètre extérieur (44) étant supérieur au diamètre intérieur (36) de ladite partie intérieure filetée desdits écrous de serrage (501), (502), (503), (504),
- tourner lesdits écrous de serrage (501), (502), (503), (504) par rapport à ladite portion filetée desdits connecteurs de pieu à boulon fileté (30), compresser lesdits joints (40) vers lesdits connecteurs de pieu à boulon fileté (30), ladite portion effilée (55) desdits écrous de serrage et ladite surface d'appui planaire (24) et établir un scellement par rapport auxdits connecteurs de pieu à boulon fileté (30) et ladite surface d'appui planaire (24).

12. Procédé d'établissement d'une fondation (10) selon la revendication 11 tournant en outre lesdits écrous de serrage (501), (502), (503), (504) dans une séquence de serrage prédéterminée fournissant une connexion précontrainte entre ledit pieu en béton armé (20) et le mât de ligne aérienne (12), mât de ligne électrique ou similaire.

13. Procédé pour couler une fondation (10) telle que revendiquée dans l'une quelconque des revendications 1-10, dans lequel ledit procédé comprend les étapes de :

- fournir un moule de coulée ayant deux parois latérales de moule, une première partie d'extrémité de moule (74) incluant des orifices (75), une deuxième partie d'extrémité de moule (76) et une partie de fond de moule,
- insérer un certain nombre d'éléments anti-adhérents faits d'un matériau synthétique, Téflon ou similaire, dans les orifices (75) de la première partie d'extrémité de moule (74),
- positionner les éléments de renforcement en acier (28) dans le moule de coulée et lesdits éléments de renforcement en acier (28) s'étendant entre ladite première partie d'extrémité (22) et ladite deuxième partie d'extrémité (26) du moule de coulée, un certain nombre de connecteurs de pieu à boulon fileté (30) étant reliés auxdits éléments de renforcement en acier (28) et permettre auxdits connecteurs de pieu à boulon fileté (30) de s'étendre au-delà de ladite première partie d'extrémité de moule (74),
- positionner un joint (40) correspondant et un écrou de serrage (501), (502), (503), (504) correspondant auxdits connecteurs de pieu à boulon fileté (30),
- déverser du béton dans le moule de coulée.
- couler un pieu en béton armé (20) définissant une structure allongée ayant une première partie d'extrémité (22) incluant une surface d'appui planaire (24) d'une première géométrie polygonale et une deuxième partie d'extrémité (24), des éléments de renforcement en acier (28) s'étendant entre ladite première partie d'extrémité (22) et ladite deuxième partie d'extrémité (24), lesdits connecteurs de pieu à boulon fileté (30) étant incorporés dans ledit pieu en béton armé (20) et ayant chacun une partie exposée s'étendant au-delà de ladite première partie d'extrémité (22) et positionnés dans une deuxième géométrie polygonale et reliés auxdits éléments de renforcement en acier (28) dudit pieu en béton armé (20), ladite deuxième géométrie polygonale étant équivalente à ladite première géométrie polygonale.

14. Procédé pour couler une fondation (10) selon la revendication 13, dans equel ledit procédé comprenant en outre les étapes de :

- disposer lesdits connecteurs de pieu à boulon fileté (30) dans le moule de coulée pour fournir un pieu en béton armé (20) ayant une première interface (60) étant située entre ladite première portion (32) et ladite portion de transition (38) de chacun desdits connecteurs de pieu à boulon fileté (30) à une première distance (d1) de ladite surface d'appui planaire (24), et une deuxième surface (62) étant située entre ladite portion de transition et ladite deuxième portion (34) de chacun desdits connecteurs de pieu à boulon fileté (30) à une deuxième distance (d2) de ladite surface d'appui planaire (24), ladite première distance (d1) étant supérieure à ladite deuxième distance (d2).

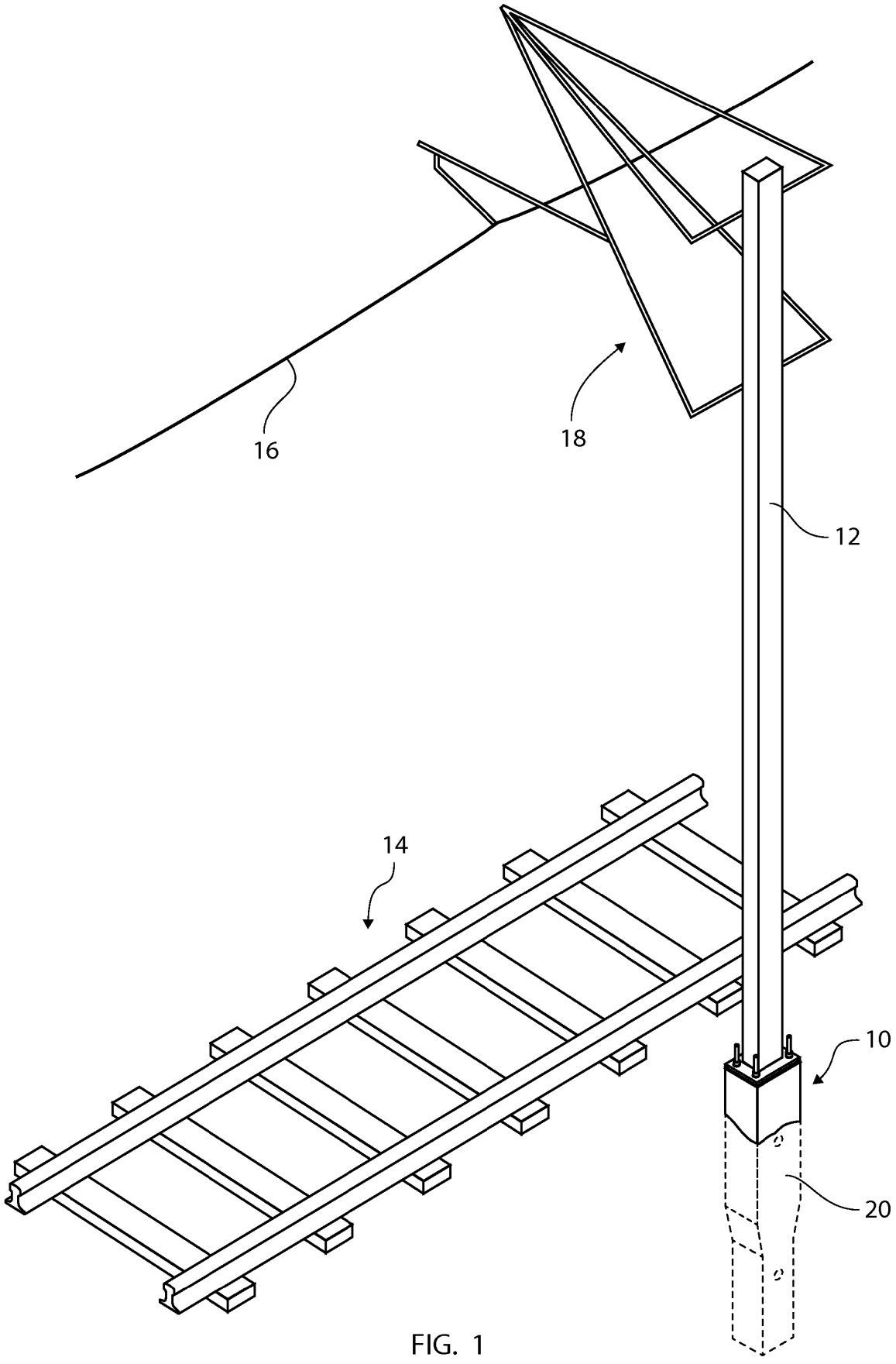


FIG. 1

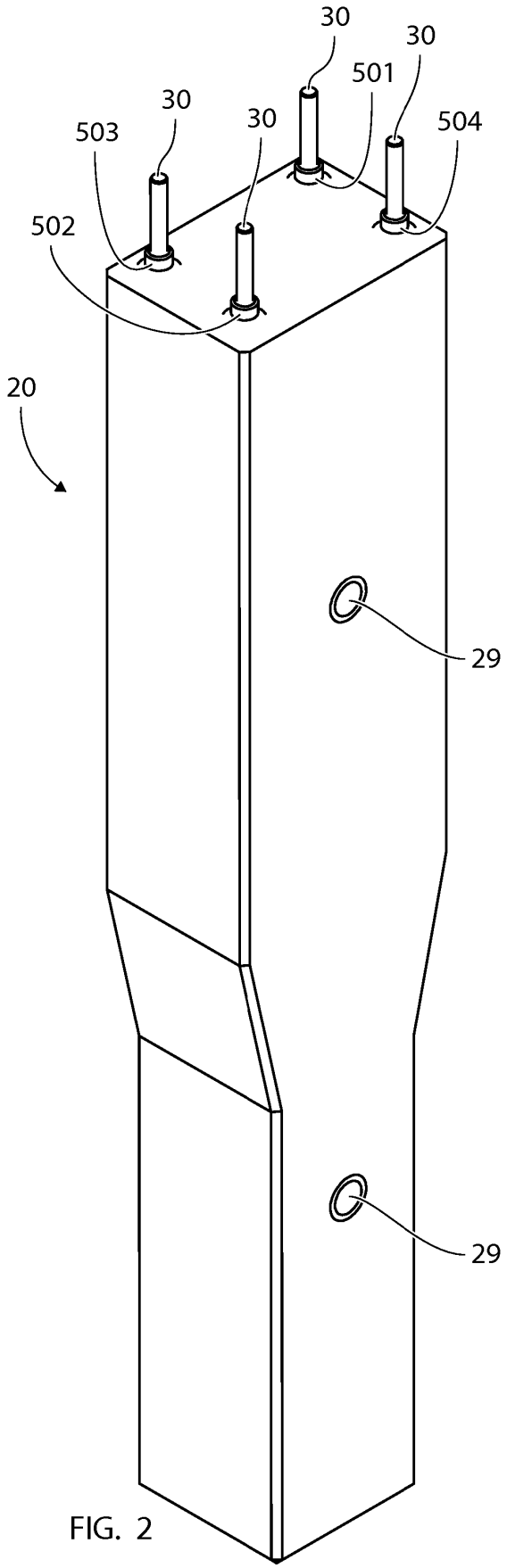


FIG. 2

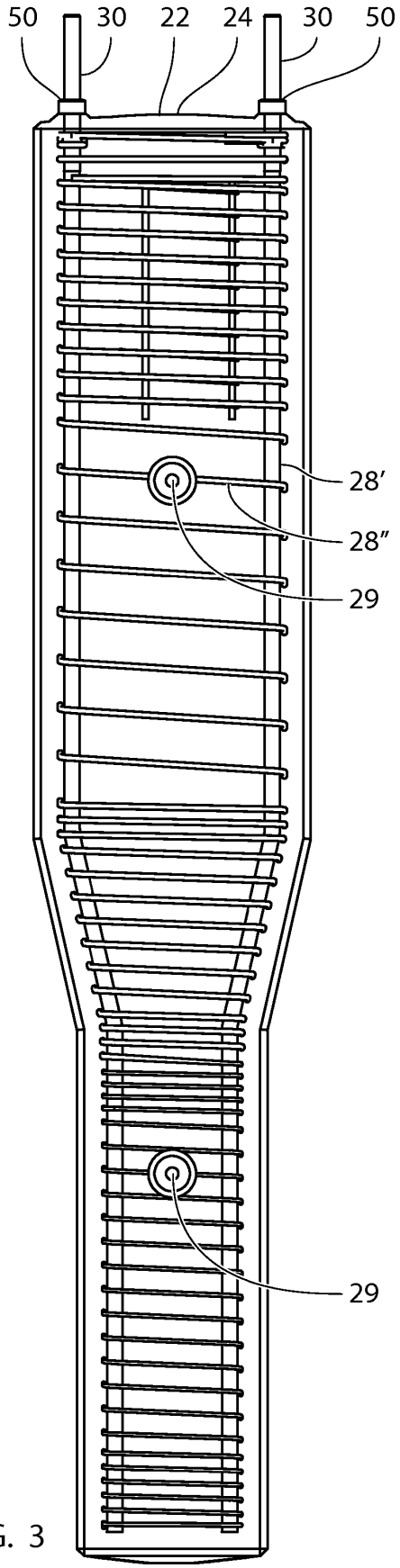


FIG. 3

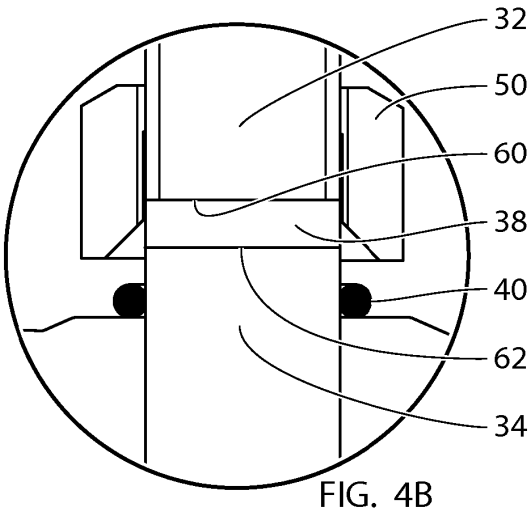


FIG. 4B

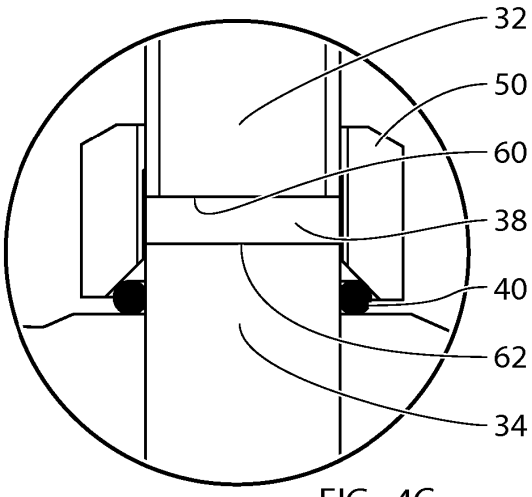
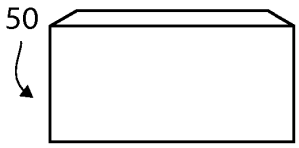


FIG. 4C

FIG. 4D

FIG. 4A



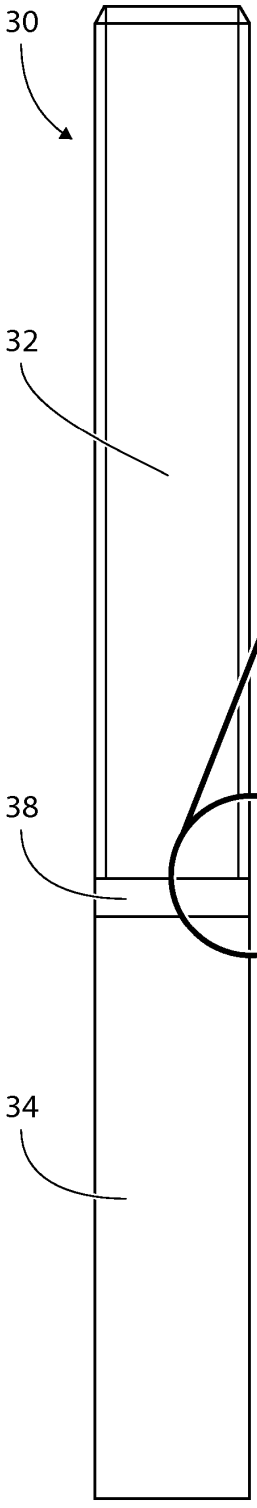


FIG. 5A

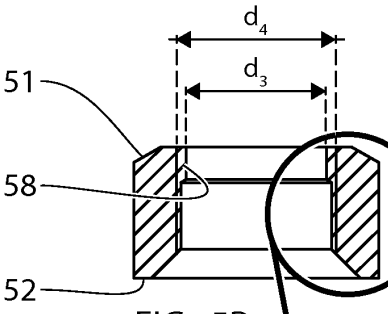


FIG. 5B

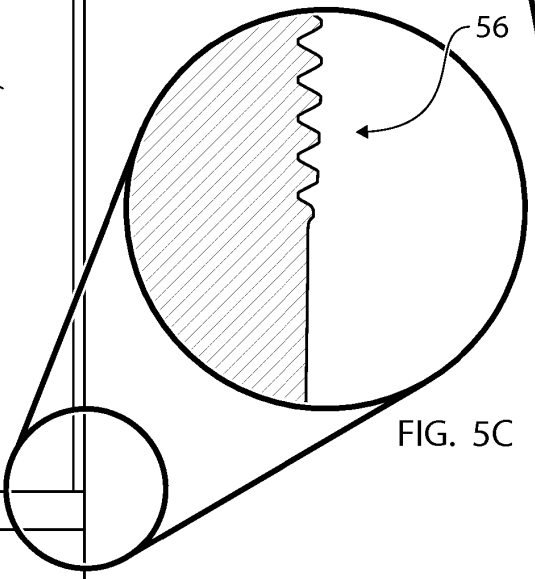


FIG. 5C

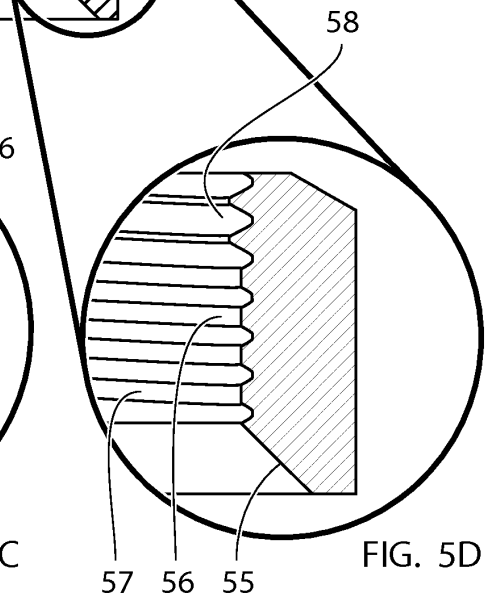


FIG. 5D

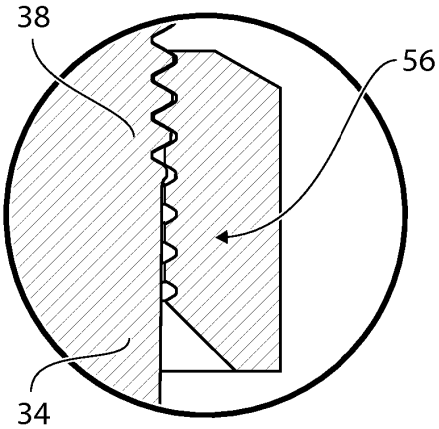
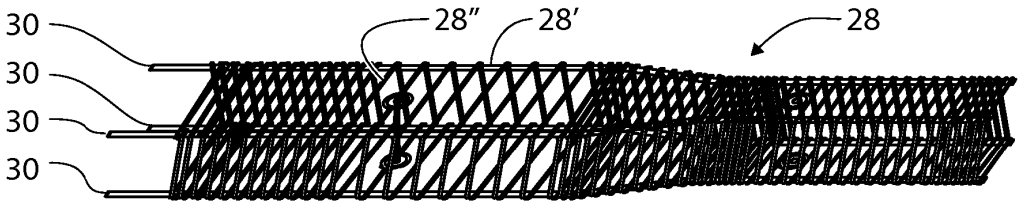


FIG. 5E



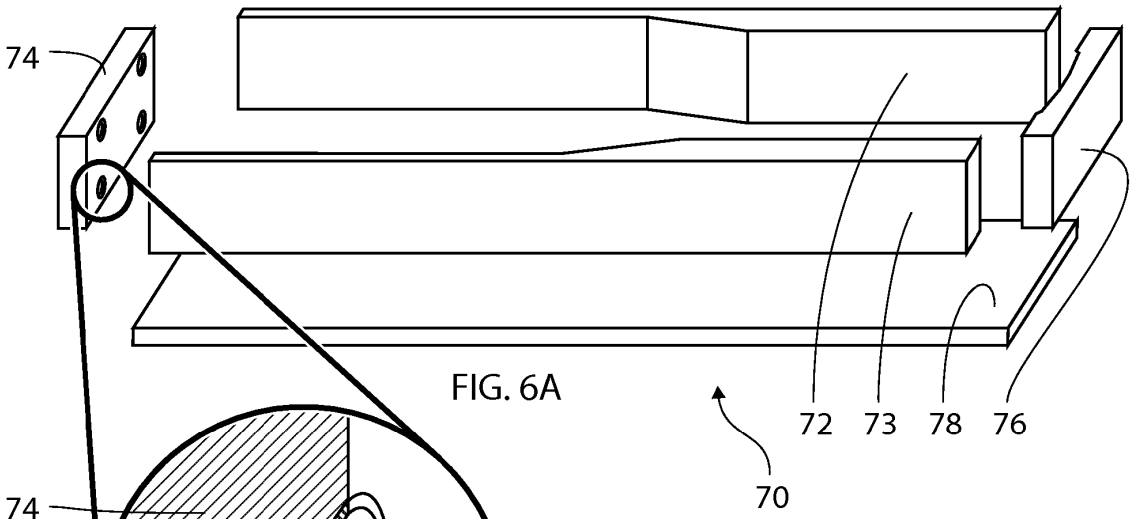


FIG. 6A

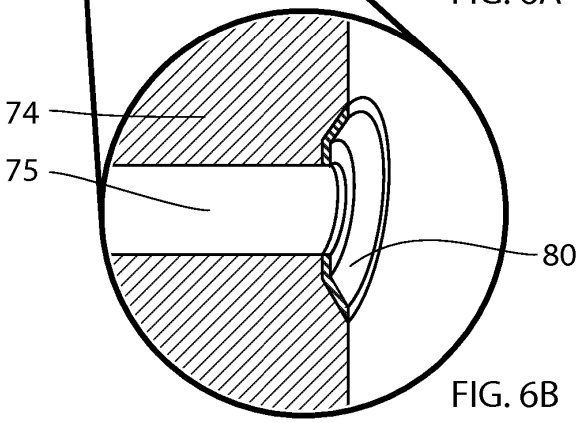


FIG. 6B

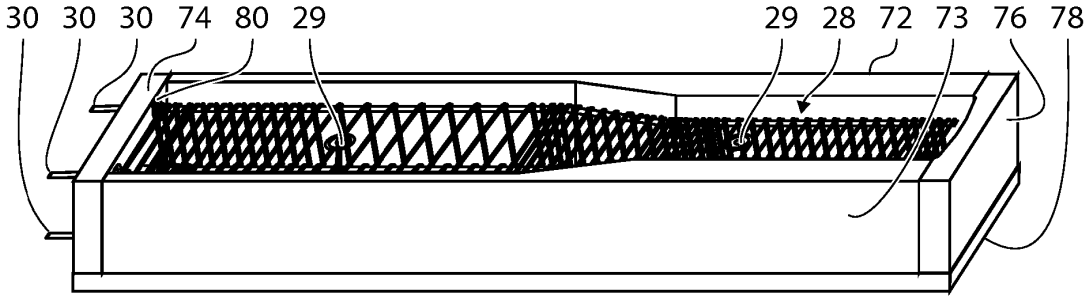


FIG. 6C

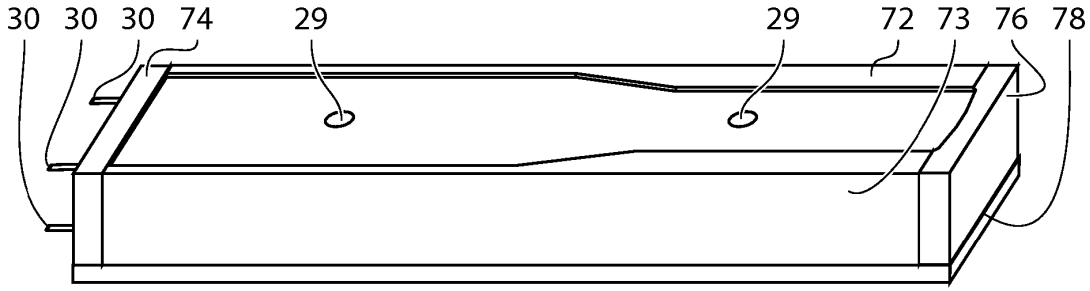


FIG. 6D

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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