Title of the Invention: Dual pipe rod assembly section with a probe arranged in the dual pipe rod assembly section, a horizontal drilling device and a probe housing

Abstract Title: Dual pipe rod assembly section with probe

A dual pipe rod assembly section comprises an inner rod section (2) and an outer rod section (1), with a probe (3) which is arranged in the dual pipe rod assembly section. The probe is arranged both in the inner rod section and rotationally coupled to the outer rod section. The rotational coupling may be provided by means of magnets located on both the probe and the outer rod section, the probe being rotatable connected to the inner rod section, which is rotatably connected to the outer rod section. The probe may be connected to the surface by means of a cable connection 13 fitted with a rotary bushing.
“Dual pipe rod assembly section with a probe arranged in the dual pipe rod assembly section, a horizontal drilling device and a probe housing”

[0001] The invention relates to a dual pipe rod assembly section including an inner rod section and an outer rod section, having a probe arranged in the dual pipe rod assembly section a horizontal drilling device and a probe housing.

[0002] In rod assembly based drilling in the ground in particular for the purpose of generating so called horizontal bore holes which extend substantially parallel or at a relatively small inclination angle relative to the ground surface, a drill head is driven by means of a drill rod assembly by a drive device which is arranged above ground or in an excavation pit. The drill rod assemblies used in this case are made of individual rod sections which are connected to one another, and which – corresponding to the drilling course – are successively placed at the rear end of the already drilled rod assembly and connected to the latter.

[0003] For rock drilling, i.e. a drilling in rock or rocky earth formations, essentially two different designs of rock drilling devices are established in the market place which function without a fast rotation of the rod assembly which is in contact with the bore hole side wall.

[0004] A first one of these designs is based on the use of an in-hole motor, which drives the drill head directly and not via the drill rod assembly. Rather, the unit of drill head and in-hole motor is fixed to the front side of the drill rod assembly via which the required axial pressure for driving the bore hole forward is applied. As in-hole motors so called “mud motors” are commonly used in which a drive fluid is conducted though a turbine under high pressure to cause the rotation.

[0005] The second common design for rock drilling devices is based on the use of a dual rod assembly which in the following is also referred to as dual pipe rod
assembly. In these machineries, the drill head is additionally rotatingly driven via an inner rod assembly of the dual pipe rod assembly by a driving device which is arranged above ground or in an excavation pit, and which also ensures the forward drive of the motor. The inner rod assembly is rotatably supported in an outer rod assembly of the dual pipe rod assembly.

[0006] In the known rock drilling devices with dual pipe rod assembly the individual rod sections of the outer rod assembly as well as the inner rod assembly are either bolted to one another or inserted into one another.

[0007] For controlling the position and the directional accuracy during drilling, it is possible to install a (measuring) probe in a housing in or on the drill head, which during drilling allows a maximally accurate position determination from above ground. The determination of the position of the drill head is usually achieved by a measuring probe which emits an electromagnetic wave. Beside the determination of the inclination angle and the rolling of the probe as well as the extension “right/left” by a receiver carried along by a user above ground (“Walk-Over-Method”) further data can be emitted by the probe via the electromagnetic wave.

[0008] The probes or respectively, sensors require a supply voltage, which can be supplied via accumulators which are arranged on the drill head or via a cable line to an external voltage source – as it is described for example in DE 196 13 788 A1. The runtime of accumulators is limited which can lead to problems when using accumulators. The use of cables on the other hand poses the risk of damage to the cable due to strong mechanical stress. When using a probe which is connected to a cable in a dual pipe rod assembly, it is known to guide the cable in the internal space between the inner rod assembly and the outer rod assembly, wherein the probe is fastened to the outer housing in the annulus.
Based on this state of the art, the invention was based on the object to provide an improved dual pipe rod assembly section with a probe arranged in the dual pipe rod assembly section, an improved horizontal drill device with such a dual pipe rod assembly section, and in particular a probe housing for a dual pipe rod assembly, in which the service time is increased and a simple mounting is nevertheless possible.

This object is solved by the independent patent claim 1. Advantageous embodiments of the dual pipe rod assembly section according to the invention are set forth in the corresponding dependent patent claims and follow from the following description of the invention. A corresponding horizontal drilling device which includes the dual pipe rod assembly section and a probe housing are the subject matter of the dependent patent claims 15 and 16. Advantageous embodiments of these devices follow from the following description of the invention.

The invention is based on the idea to provide a possibility for the protection of a probe, and in the case of a probe connected to a cable, protection for a corresponding cable for a dual pipe rod assembly, in which the probe and the cable are protected, whereby the service life of the dual pipe rod assembly is increased, the accuracy however, of the measurements of the probe in the dual pipe rod assembly and/or the transmission of the measurement values during the drilling can nevertheless be assessed very accurately.

According to the invention, this is achieved in that the probe is arranged in the inner rod section, and thus is surrounded by the inner rod section and protected, however, the probe is still decoupled from the inner rod section, i.e. the inner rod assembly which carries or receptively drives the drill head and is rotatiningly coupled with the outer rod assembly. The probe is arranged inside the inner rod assembly and the respective cable provided for voltage supply to the probe can be guided inside the inner rod assembly. A strong mechanical stress on the cable and/or
the probe is eliminated. The service life of the dual pipe rod assembly with the probe arranged in the latter is increased.

[0013] The terms inner rod section and outer rod section relate to a section of the inner rod assembly or respectively the outer rod assembly. The rod sections can be connected to one another via a threaded engagement or by inserting the rod sections into one another.

[0014] When the probe is described to be arranged inside or in the inner rod section this means that the probe is located in a region which is defined by the outer cross section of the inner rod section. The probe thus can also be arranged on the inner rod section, if the probe is located within the border which is defined by the outer circumference of the inner rod section. Particularly preferably, the probe is arranged within the inner rod section in such a manner that the probe and/or the probe housing do not come into contact with the inner rod section so as to co-rotate with the inner rod section.

[0015] A dual pipe rod assembly which according to the invention has a inner rod section and an outer rod section with a probe arranged in the dual pipe rod assembly section has thus a probe which is arranged in the inner rod section of the dual pipe rod assembly section and rotatively coupled to the outer rod section. While the inner rod section is rotatable relative to the outer rod section, the probe is arranged in the inner rod section so that it co-rotates with the outer rod section. The probe follows the rotational movement of the outer rod section; the rotational movement of the outer rod assembly is imposed on the probe. The rotational speed of the outer rod assembly is significantly smaller than the speed of the inner rod assembly in a dual pipe rod assembly.

[0016] In order to enable an additional protection of the probe or respectively, of the cable which is provided to be connected to the probe, and to increase the
service life of the dual pipe rod assembly, the probe is preferably arranged centrically in a housing in the inner rod section, which also achieves an overall small design, which allows carrying out smaller bore hole diameters. Faster and cheaper pilot drillings can be carried out. Further, a centric mounting of the probe causes the latter to always register the same field strength to the surface, no deviations exist in contrast to the previous case when the field strength was weakened by the drive shaft as a result of a lateral mounting of the probe and no symmetrical field was possible. Contrary to the widely held opinion, the probe has surprisingly been shown to be able to be arranged centrically, which allows achieving a greater accuracy of the measurement.

[0017] Preferably, the dual pipe rod assembly section has at least two magnets for the rotational coupling of the outer rod section and the probe, one of which magnets is arranged in the outer rod section and one in the inner rod section on the probe or respectively, a probe housing, and oriented toward one another so that the at least two magnets interact with one another, i.e. attract one another in order to achieve the rotational coupling. By using magnets for achieving the rotational coupling, a contactless interaction of probe position and outer rod section is established in which components which may engage with one another and are subjected to mechanical stress or to wear can be omitted. Preferably, the magnet which is arranged on the inner rod section on the probe can be an electromagnet, in order to increase the interaction. In order to increase the interaction, neodymium-magnets can be used for the magnet in the outer rod section as well as for the magnet in the inner rod section.

[0018] In addition, the probe can preferably be arranged between two end-side connection parts in a ring shaped section of a nonmagnetic material of the inner rod section. This allows ensuring a simple mounting, wherein the ring shaped section which is made of a nonmagnetic material, and is in particular constructed of interconnected layers of carbon fibers, allows an accurate measuring of the position
and/or direction. The nonmagnetic material is preferably an antimagnetic pipe or a CFK-pipe; such materials have also proven useful for transmitting great forces as they are required in the inner rod assembly. This allows achieving a long service life. The connection parts can be rotatably supported in the outer rod section. The support is preferably realized via a rolling bearing, in particular a low-maintenance rolling bearing. Rotatably supporting the connection parts in the outer rod section allows a decoupling of the rotational movement of the outer rod assembly and the inner rod assembly.

[0019] It is further preferred that the tube shaped section of the inner rod section is connected to the connection parts via a connection element, particularly preferably an bonding sleeve, which allows a rotationally fixed rigid connection, which allows achieving a rotational coupling with the outer rod section by decoupling the rotational movement of the inner rod assembly, with which an adjustment via variable dimensions of the bonding sleeve is established. The bonding sleeve enables an adhesive bond by means of an adhesive, to carry out a low-temperature joining to achieve a connection which has a long service life.

[0020] For a simple structural configuration for decoupling the rotation of the inner rod assembly, the probe is supported in a receptacle for rotation relative to the connection parts. The rotation of the inner rod assembly is thus enabled by the connection parts which are supported for rotation relative to the inner rod assembly, which connection parts have themselves a rotatably supported receptacle for the probe, wherein preferably low-maintenance rolling bearings are used.

[0021] In a preferred embodiment of the present invention, the rotational coupling of probe and outer rod assembly in the tough and harsh conditions during use in the ground is achieved via a magnetic coupling of at least two magnets, wherein at least one of the magnets is fastened to the receptacle for interacting with
a magnet which is fastened on the outer rod assembly. Via the magnets a force transmission or respectively, a force exchange is possible without moving elements.

[0022] For simple mounting in an opening of the outer rod assembly, the magnet which is fastened to the outer rod section can be insertable into an opening which is adjusted to the outer diameter of the magnet, which opening is closable via a closing element which is subsequently insertable from the outside. The arrangement of the magnet on/in the outer rod section is thus achieved via a connection which is realized inside the sheath of the outer rod section. The magnet on the outer rod assembly is located in the sheath of the outer rod section, without coming into contact with the soil. In particular, beside a clamping or a bonding closure, a screwable locking screw can be provided as closing element, which locking screw can be screwed into an inner threading of the sheath of the outer rod assembly which inner threading is provided in at least a partial area of the opening. The locking screw allows a simplified exchange of a magnet.

[0023] Further, slots can be provided which are adjusted to the arrangement of the probe in the inner rod section, which slots allow electromagnetic waves emitted by the probe to exit independent of the material of the outer rod section.

[0024] For additional protection of the probe of the measurement system for determining position and direction for the drill head, a cable connection for the probe is preferably arranged centrically in the inner rod assembly, which because of the centric location leads to the fact that no rotation forces act on the cable during operation of the dual pipe rod assembly.

[0025] In a preferred embodiment, the connection part which faces away from the drill head has a rotation opening for the cable, whereby a mechanical rotation movement of the connecting part is decoupled from the traversing cable, which
increases the service life of the dual pipe rod assembly section or respectively the maintenance intervals.

[0026] Preferably, bore holes which extend in the outer rod section for transporting drilling fluid are formed, whereby due to the separation of the drilling liquid or respectively drilling fluid from the probe which is arranged in the dual pipe rod assembly the stress exerted on the probe is decreased, because the pressurized drilling fluid does not come into contact with the probe.

[0027] In a further preferred embodiment of the dual pipe rod assembly section according to the invention the outer rod section is made of a non magnetic material, which increases the quality of the direction and/or position determination of the drill head or respectively, the probe.

[0028] A dual pipe rod assembly section according to the invention can preferably be used as a dual pipe assembly section for a horizontal drilling device.

[0029] Further, a probe housing for a dual pipe rod assembly of a horizontal drilling device is created, which has end-side arranged connecting parts, which each are connectable at their ends to an inner rod section and/or the drill head. The connection parts have a receptacle for a bearing for rotatable support in an outer rod section, and a tube shaped section of a nonmagnetic material which surrounds the probe is formed between the connection parts, in which tube shaped section the probe is supported for rotation relative to the connection parts, wherein a rotational coupling of the probe and the outer rod section is established.

[0030] In the following, the invention is explained in more detail by way of the exemplary embodiments shown in the drawings.

[0031] In the drawing it is shown in:
[0032] Fig. 1 in a schematic representation a dual pipe rod assembly according to the invention in a longitudinal section;

[0033] Fig. 2 the dual pipe rod assembly according to Fig. 1 in a view rotated by 90°;

[0034] Fig. 3 the dual pipe rod assembly section according to Fig. 1 in a cross section in the region for slots in the outer rod section;

[0035] Fig. 4 the dual pipe rod assembly section according to Fig. 1 in a cross section in the region of magnets which are arranged toward each other in the outer rod section and inner rod section.

[0036] Fig. 1 shows a dual pipe rod assembly section according to the invention, as it can be used for a rotation-controlled rock drilling system of an HDD-drilling system. HDD here denotes a "Horizontal Directional Drilling". The dual pipe rod assembly section has an outer rod section 1 and an inner rod section 2. A probe 3 is arranged in the inner rod section 2. The probe 3 is centrically arranged in a housing in the inner rod section 2.

[0037] For decoupling the rotational movement of the inner rod section 2 from a rotational movement of the outer rod section 1, the inner rod section 2 is supported in the outer rod section 1 by bearings 4 for rotation relative to the outer rod section 1. The bearings 4 are provided between the outer rod section 1 and connection parts 5 which are arranged end-side to the inner rod section 2. The inner rod section 2 is supported via the bearings 4 for rotation relative to the outer rod section 1, wherein the inner rod section 2 is fixed non shiftable relative to the outer rod section 1.
A tube shaped section 6 made of a nonmagnetic material extends between the end-side connecting parts 5. The tube shaped section 6 surrounds the probe 3. For connecting the tube shaped section 6 to the bearings 4, connection elements 7 are provided between the connection part 5 and the tube shaped section 6, which connection elements 7 can be configured in the form of bonding sleeves. The connection elements 7 embrace the connection part 5 in a partial section and are themselves embraced in a region by the tubes shaped section 6.

The probe 3 is rotatably supported in the tube shaped section 6. The rotatable support allows the probe 3 to rotate relative to the inner rod section 2. The rotatable support of the probe 3 relative to the inner rod section 2 is achieved by bearings 8 which are provided between the connection element 7 and end-side receptacles 9 for the probe 3. The receptacles 9 are thus rotatably supported in the connection elements 7 via the bearings 8 and can thereby rotate freely.

A magnet 10 is provided on at least one receptacle 9 at a defined position on or respectively, in the outside. The magnet 10 can for example be inserted into the receptacle 9 from outside. At a predetermined position which corresponds to the position of the magnet 10 with regard to the longitudinal axis of the inner rod section 2, at least one further magnet 11 is provided in the outer rod section 1, which magnet 11 interacts with the magnet 10. The magnetic poles of the magnets 10, 11 are oriented so that the magnets 10, 11 attract one another. In this way, the receptacle 9 and with this the probe 3 which is connected to the receptacle 9 in a rotationally fixed manner can always follow the rotational movement of the outer rod section 1. The probe 3 is rotationally coupled to the outer rod section 1.

While the torque for the drive of the drill head which in the representation of Fig. 1 and 2 can be attached to the connection part 5 on the left side of the inner rod assembly 2, is provided via the inner rod assembly 2 of the dual pipe rod assembly and transmitted to the connection elements 7 and the tube shaped
section 6 via the connection parts 5, the probe 3 can rotate independent therefrom in the inner rod section 2. The connection parts 5, the connection elements 7 and the tube shaped section 6 are rotatable relative to the probe 3 and the outer rod section 1, without co-rotating of the probe 3 and the outer rod section 1. The interaction between the magnets 10, 11 causes the probe 3 to follow the rotational movement of the outer rod section 1. The magnetic interaction establishes a rotational coupling of the receptacle 9 and the probe 3 which is connected to the receptacle 9 in a rotationally fixed manner, relative to the outer rod section 1. The probe 3 is located in a space which is defined between the two connection elements 7 and within the tube shaped section 6, wherein due to the rotatable support on the connection elements 7 the probe 3 can rotate independent of the inner rod assembly 2. While the rotational coupling of the inner rod sections to one another and to the drill head is achieved via the connection elements 7 and the receptacle 5, the bearings 8 offer a possibility for rotationally coupling the rotation of the probe 3 relative to the inner rod assembly 2, even though the probe 3 is located within the inner rod assembly 2.

[0042] The magnet 11 is inserted into an opening of the outer rod section 1, which opening at least in a partial area thereof has an internal threading and can be closed via a locking screw 12. The head of the locking screw 12 is preferably flush with the outer surface of the outer rod section 1 or lies underneath this surface. The magnet 11 is connected to the locking screw 12 or is inserted into the locking screw 12 with its end side.

[0043] For connecting the probe 3 which is arranged centrically in the inner rod section 2, a passage with a cable connection 13 is provided, which passage extends through the receptacle 9 which is located at a distance from the drill head, wherein a rotary bushing 14 is provided for a cable 15. The cable connection 13 of the probe 3 is thus connected to a rotary bushing 14, so that the cable 15 which leads to the drilling device cannot become twisted. The rotary bushing 14 is oriented centrically
relative to the receptacle 9 and the connecting part 5. The cable 15 is guided centrically in the inner rod section 2 and the outer rod section 1.

[0044] The outer rod section 1 has two slots 16 in the region of the probe 3, which slots 16 preferably extend over the region of the probe 3 or respectively, the probe housing. Multiple slots 16 are provided adjacent one another in longitudinal direction of the outer rod section 1. The slots 16 are distributed radially in the outer rod section 1 and have preferably equal angular distances between one another.

[0045] For transporting drilling fluid, in particular bentonite containing fluid, bores 17 are provided in the outer rod section 1, which bores 17 extend in longitudinal direction of the outer rod section 1. Multiple bores 17 are provided which are circumferentially distributed in the outer rod section 1, and which have equal angular distances between one another.
Patent claims:

1. Dual pipe rod assembly section comprising an outer rod section (1) and an inner rod section (2) with a probe (3) arranged in the dual pipe rod assembly section, characterized in that the probe (3) is arranged rotationally coupled to the outer rod section (1) in the inner rod section (2).

2. Dual pipe rod assembly section according to claim 1, characterized in that the probe (3) is centrically arranged in a housing in the inner rod section (2).

3. Dual pipe rod assembly section according to claim 1 or 2, characterized in that for the rotational coupling at least one magnet (10, 11) is provided in the inner rod section (2) and the outer rod section (1) for interacting with one another.

4. Dual pipe rod assembly section according to one of the claims 1 to 3, characterized in that the inner rod assembly has a tube shaped section (6) of a non magnetic material between two end-side connection parts (5) which are supported for rotation relative to the outer rod section (1).

5. Dual pipe rod assembly section according to claim 4, characterized in that the tube shaped section (6) of the inner rod section (2) is connected to the connection parts (5) via a connection element (7).

6. Dual pipe rod assembly section according to claim 5, characterized in that the connection element (7) is a bonding sleeve.

7. Dual pipe rod assembly section according to one of the claims 4 to 6, characterized in that the probe (3) is supported in a receptacle (9) for rotation relative to the connection parts (5).
8. Dual pipe rod assembly section according to claim 7, characterized by at least one magnet (10) which is fastened on the receptacle (9) for interacting with a magnet (11) which is fastened on the outer rod section (1).

9. Dual pipe rod assembly section according to claim 8, characterized in that the magnet which is fastened on the outer rod section (1) is insertable in an opening which is adjusted to the outer diameter of the magnet (11) of the outer rod section (1), which opening is closable via a locking element (12).

10. Dual pipe rod assembly section according to claim 9, characterized in that the opening has at least in a partial region thereof an internal threading, into which a locking screw is screwable as locking element (12).

11. Dual pipe rod assembly section according to one of the claims 1 to 10, characterized in that slots (16) are provided in the outer rod section (1) which are adjusted to the arrangement of the probe (3) in the inner rod section (2).

12. Dual pipe rod assembly section according to one of the claims 4 to 11, characterized in that a cable connection (13) for the probe (3) is provided centrically in the inner rod section (2) with a rotary bushing (14) for the cable (15) in the connection part (5) and faces away from an end of the dual pipe rod assembly on which a drill head is disposed.

13. Dual pipe rod assembly section according to one of the claims 1 to 12, characterized in that bores (17) which extend in the outer rod section (1) are provided for transporting drilling fluid.

14. Dual pipe rod assembly section according to claim 1, characterized in that the outer rod section (1) is formed from a non magnetic material.
15. Horizontal drilling device, characterized by a dual pipe rod assembly section according to one of the claims 1 to 14.

16. Probe housing for a dual pipe rod assembly of a horizontal drilling device with end-side arranged connection parts (5), which each are connectable end-side to an inner rod section (2) and/or a drill head and have a receptacle for a bearing (4) for rotational support in an outer rod section (1), and a tube shaped section (6) made of a non magnetic material which surrounds the probe (3) is formed between the connection parts (5), in which tube shaped section (6) the probe (3) is supported for rotation relative to the connection parts (5), wherein a rotational coupling of the probe (3) and the outer rod section (1) is established.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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E21B

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