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Octrooihouder(s):

A.P. van den Berg Holding B.V. te Heerenveen.

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Uitvinder(s):

Bauke Cornelis Regnerus te Hilaard.

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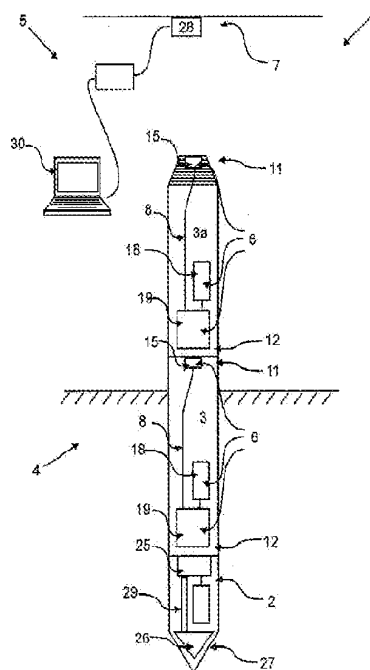
Ir. H.V. Mertens c.s. te Rijswijk.

(54)

Soil probing device.

(57)

A soil probing device (1) comprising a measuring probe (2), a plurality of rod sections (3) for the assembly of a probing rod (4) comprising the measuring probe (2), which probing rod (4), while being pushed into the soil, is extendable each time by one or more rod sections (3), and a base unit (5). Each rod section (3) comprises first communication means (6) for wireless communication between the consecutive rod sections (3) in the probing rod (4) and the base unit (5) comprises second communication means (7) for wireless communication with the first communication means (6) of the last rod section (3a) of the probing rod (4).

**NL C 2002608**

Dit octrooi is verleend ongeacht het bijgevoegde resultaat van het onderzoek naar de stand van de techniek en schriftelijke opinie. Het octrooischrift wijkt af van de oorspronkelijk ingediende stukken. Alle ingediende stukken kunnen bij NL Octrooiencentrum worden ingezien.

Title: **Soil probing device**

Description

Field of the invention

5 The present invention relates to a soil probing device comprising a measuring probe, a plurality of rod sections for the assembly of a probing rod comprising the measuring probe, which probing rod, while being pushed into the soil, is extendable each time by one or more rod sections, and a base unit.

10

Background of the invention

To transfer signals from the measuring probe to the base unit many
15 different soil probing devices have been developed. One example uses a continuous wire through every rod section in the probing rod. Via such a wire an optical or electrical signal can be transferred. Because of the wire being present in a plurality of rod section such a soil probing device is difficult to handle and
20 to store. Moreover it is not flexible in case different depths have to be probed. Another example uses connections between wired sections in the rod sections. However, this requires precise linking of the wired sections which is labour intensive or requires complex coupling means. furthermore, these connections are
25 sensitive to moisture and mechanical stress.

To overcome the problems mentioned above, many soil probing devices use specific rod sections able to transfer signals wirelessly along the probing rod. This wireless signal can be optical or acoustic.

30

Problems with known soil probing devices using wireless communication means is that each time the probing rod is extended with one rod section the probing is delayed. This delay is mostly due to combining the last rod section and the base unit such that
35 communication is possible. Mostly converting means, converting the

wireless signal to an electrical signal, have to be coupled mechanically to the last rod section.

Another problem relating to known soil probing devices using
5 wireless communication means is that the wireless signal loses its strength along the probing rod. This limits the depth that can be probed using the soil probing device. Acoustic signals, propagating through the material of the rod section, are sensitive to noise in the ground, caused by heavy equipment above ground level and the
10 friction between the probing rod and the soil. Soil probing devices using wireless communication means for optical signals propagating through elongated elements in the probing string cope with this problem by inserting amplifiers between the regular optical signal propagating rod sections. This makes the assembly of the probing
15 string more complex. In this soil probing device only the amplifier can communicate directly with the base unit.

Therefore, it is an object of the present invention to provide an improved soil probing device alleviating the above mentioned
20 problems.

Summary of the invention

Therefore the invention provides a soil probing device comprising a
25 measuring probe, a plurality of rod sections for the assembly of a probing rod comprising the measuring probe, which probing rod, while being pushed into the soil, is extendable each time by one or more rod sections, and a base unit, characterized in that, each rod section comprises first communication means for wireless
30 communication between the consecutive rod sections in the probing rod, and the base unit comprises second communication means for wireless communication with the first communication means of the last rod section of the probing rod.

35 Because of the possibility of wireless communication between the base unit, which is located above ground level of the soil probing location, and the last rod section in the probing rod, the probing rod can be extended more rapidly. Another advantage is that all rod sections are equal and all rod sections are able to communicate
40 with the base unit.

With "last rod section" is meant the rod section which is used most recently to extend the probing rod. Preferably the rod section is coupled mechanically to the second last rod section. Preferably
5 coupling of the last rod section prevents communication of the second last rod section with the base unit and initiates communication of the last rod section with the base unit.

It is noted that US 2006196664 describes a remote power management
10 method and system in a downhole network like a drilling rig. In this system a data transmission path through a plurality of down-hole rod sections is present. The communication system used for this data transmission path through the rod sections can be inductive couplers, direct electrical contacts or optical couplers.
15 Between the upper down-hole rod section and a top-hole processing element a wireless data connection can be provided. The type of communication system used for this wireless data connection has not been specified.

20 In US 2005285751 a similar type of downhole oil and gas drilling network has been disclosed using burst modulation techniques as communication system. Communication links between the rod sections may be wireless connections. The communication system used between the upper rod section and a top hole personal computer has not been
25 specified.

Both US 20060196664 and US 2005285751 relate to the field of drilling for oil, gas or other fluids, and thus relate to a field different from the one according to the invention, that is to say
30 soil probing.

The measuring probe according to the present invention comprises at least one sensor for obtaining information (e.g. physical and chemical characteristics) about the soil. The measuring probe can,
35 for example, be a penetrometer comprising a cone for measuring the cone resistance, a friction sleeve for measuring side friction, and optionally sensors for measuring other parameters such as, for example, probe inclination, equilibrium water pressure, etc. Alternative designs of the probe are also possible, however.

The soil can be sand, clay, silt, in which case the probing rod can be pushed into the soil using e.g. a hydraulic drive mechanism. Alternatively, the soil can be rock, in which case the probing rod can be equipped with a suitable drilling point and can be drilled
5 into the rock. The soil can also comprise liquids, primarily water solutions, and gases. The soil probing device can be used in all types of geological investigation, including geotechnical investigations on land and off-shore investigations.

10 In an advantageous embodiment of the invention the first communication means comprise a wired section for wired transmission of the signal along the rod section. Due to this wired section substantial loss of signal along the probing rod can be avoided. Therefore a relatively long probing rod can be assembled. The wired
15 section could transfer electrical, optical or radiofrequency signals. Preferably the first communication means comprise at each end of the rod section elements for wireless communication, which elements are connected, directly or indirectly, with each other via the wired section.

20 Preferably the rod sections comprise battery means for supplying energy to the first communication means.

In another advantageous embodiment of the invention the first
25 communication means and second communication means are both optical communication means.

In yet another advantageous embodiment of the invention the first communication means and second communication means are radio
30 frequency (RF) communication means. The advantage of RF signals is that they are relatively easy to detect so the second communication means can be located at varying positions relative to the last rod section.

35 In yet another advantageous embodiment of the invention the rod sections comprise communication interfering means. These communication interfering means prevent impeding communication, for example communication between non-consecutive rod sections or between rod section other than the last rod section and the base

unit. Preferably rod sections not being part of a probing rod are not able to communicate at all.

Preferably the communication interfering means are functioning such
5 that coupling of a first end of a second last rod section to a second end of the last rod section to extend the probing rod abolishes the interfering function. This is to prevent a wireless signal being received by a rod section that is not part of the probing rod while it is still possible to transfer the wireless
10 signal along the probing rod. The first end should not have interfering means because that end, while being part of the last rod section, should communicate with the base unit. This means that the rod sections have distinctive ends. Preferably coupling of the last rod section "activates" or "awakes" this rod section through
15 the second end. The interfering means subsequently also prevent a rod section being "activated" or "awaked" while not being part of a probing rod, for example while being stored.

Preferably, the communication interfering means are functioning
20 such that communication between first communication means of rod sections in the probing rod other than the last rod section and the second communication means is prevented.

Preferably, the communication interfering means comprise a tubular
25 extension of the rod section. For example, if the first communication means and second communication means are radio frequency communication means and the radio frequency signal is around 2,4 GHz and the diameter of the tubular extension is 16 mm a tubular extension of around 4 cm is sufficient to prevent
30 communication. Preferably the second communication means are similar to the first communication means but in stead do not comprise the interfering means. Preferably the tubular extension comprises internal screw-thread and the first end comprises external screw thread for connecting the first end of one rod
35 section to the second end of another rod section to allow for transmission of a wireless signal in a probing rod.

Preferably, the rod sections comprise an inner tube comprising the first communication means and an outer tube comprising the
40 communication interfering means. All electronics of the first

communication means can be surrounded and thereby protected by the inner tube. Preferably, the inner tube is made of nonconductive material, such as plastic. This inner tube, comprising the first communication means, can be produced separately from the outer tube. Preferably the inner tube can be pushed into the outer tube and be fixed such that the interfering means are functional.

In yet another advantageous embodiment of the invention, the first communicating means and the second communicating means are able to communicate via a protocol. A communication protocol could optimize communication and energy consumption. Preferably the rod sections are "sleeping" when stored or when not in use and are "awakened" when coupled to be a part of the probing rod. Preferably, abolishing the interfering function of the interfering means by coupling of a rod section "awakes" that rod section. Examples of wireless communication protocols are Bluetooth, ultra wideband (UWB), wireless fidelity (Wi-Fi) and Zigbee.

Brief Description of the Drawings

These and other aspects of the invention will be apparent from the preferred embodiment more clearly described with reference to the appended drawings.

Fig 1 shows a schematic view of a preferred embodiment of the soil probing device according to the invention
Fig 2 shows an inner and an outer tube of a rod section.

Detailed description of preferred embodiment

The following description of a preferred embodiment is related to a soil probing device (1) comprising a measuring probe (2), two rod sections (3 and 3a) which are assembled to a probing rod (4) comprising the measuring probe (2), and a base unit (5). This schematic view shows only two rod sections (3 and 3a) but of course in practice the probing rod will be extended by many other rod sections while being pushed into the soil. Each rod section (3 and 3a) comprises first communication means (6) for wireless communication between the consecutive rod sections (3 and 3a) in

the probing rod (4), and the base unit (5) comprises second communication means (7) for wireless communication with the first communication means (6) of the last rod section (3a) of the probing rod (4). In this preferred embodiment the first communication means (6) and second communication means (7) are both radio frequency (RF) communication means. The rod sections (3 and 3a) clearly comprise distinctive ends, where the first end (11) comprises a first antenna (15) at the end of an external screw-thread (31) containing part. The second end (12) comprises a second antenna (17) (not shown), a battery (18), and a controller (19). The controller (19) comprises a first transceiver (20) (not shown) related to the first antenna (15), and a second transceiver (21) (not shown) related to the second antenna (17) (not shown), a microprocessor (22) (not shown), and a power supply circuit (23) (not shown). The first transceiver (20) (not shown) and the second transceiver (21) (not shown) allow for communication in both directions. Measurement data from the measuring probe (2) can be transferred to the base unit (5) and the base unit (5) can send commands to the measuring probe (2). The base unit (5) could for example send a control command in order to actuate or switch off the measuring means. The wired section (8) in the rod sections (3) comprises a coax cable (24) connecting the first antenna (15) with the controller (19). The measuring probe (2) comprises third RF communication means (25) which can communicate with a measuring element (26) in the cone (27) via a first RS485 bus (29). The base unit (5) comprises fourth RF communication means (28) to communicate with the first communication means (6) of the last rod section (3a) and is able to communicate with a computer (30) via a second RS485 bus (33) (not shown). Fig. 2 clearly shows the interfering means (10) in the form of a tubular extension (12) of the outer tube (14), which interfering means (10) prevent impeding communication to occur. It also shows the inner tube (13) comprising the first communication means (6), that is, battery means (9), the wired section (8), the first antenna (15), and the controller (19). The outer tube in this preferred embodiment comprises external screw-thread (31) at the first end (11) and internal screw thread (32) at the second end (12) for connecting the first end (11) of one rod section (3) to the second end (12) of another rod section (3) to allow for transmission of a wireless signal in a probing rod. Shown is that when the inner tube (13) is

pushed into the outer tube (14) correctly, the first antenna will be at the uttermost part of the first end (11) and the controller (19), comprising the second antenna (17) (not shown) will be shielded by the interfering means (10). By coupling the rod section
5 by using the internal (32) and external screw-thread (31) the first antenna (15) approaches the second antenna (17) such that communication and transfer of wireless signal is possible.

Conclusies

1. Bodemsondeerinrichting (1) omvattende:

- 5 - een meetsonde (2),
- een pluraliteit aan stangsecties (3) voor de schikking van
 een sondeerstang (4) omvattende de meetsonde (2), welke
 sondeerstang (4), terwijl deze in de bodem wordt gedrukt
 elke keer door een of meer stangsecties (3) verlengbaar
10 is, en
- een basiseenheid (5),

 waarbij elke stangsectie (3) eerste communicatiemiddelen (6) omvat
 voor draadloze communicatie tussen de opeenvolgende stangsecties
15 (3) in de sondeerstang (4)

met het kenmerk, dat de basiseenheid (5) tweede
 communicatiemiddelen (7) omvat voor draadloze communicatie met de
 eerste communicatiemiddelen (6) van de laatste stangsectie (3a)
 van de sondeerstang (4).

20

2. Bodemsondeerinrichting (1) volgens conclusie 1, **met het kenmerk,**
 dat de eerste communicatiemiddelen (6) een bedrade sectie (8)
 omvatten voor bedrade overdracht van het signaal door de
 stangsectie (3).

25

3. Bodemsondeerinrichting (1) volgens conclusie 2, **met het kenmerk,**
 dat de stangsecties (3) batterijmiddelen (9) omvatten om te
 voorzien in energie voor de eerste communicatiemiddelen (6).

30 4. Bodemsondeerinrichting (1) volgens conclusie 1 of 2, **met het**
 kenmerk, dat de eerste communicatiemiddelen (6) en de tweede
 communicatiemiddelen (7) beide optische communicatiemiddelen zijn.

35 5. Bodemsondeerinrichting (1) volgens één der conclusies 1-3, **met het**
 kenmerk, dat de eerste communicatiemiddelen (6) en tweede
 communicatiemiddelen (7) beide radio-frequentie-
 communicatiemiddelen zijn.

6. Bodemsondeerinrichting (1) volgens één der conclusies 1-5, **met het kenmerk, dat** de stangsecties (3) communicatie-interfererende middelen (10) omvatten.

5 7. Bodemsondeerinrichting (1) volgens conclusie 6, **met het kenmerk, dat** de communicatie-interfererende middelen (10) zodanig functioneren dat de koppeling van een eerste uiteinde (11) van een tweede laatste stangsectie (3b) aan een tweede uiteinde (12) van de laatste stangsectie (3a) voor het verlengen van de sondeerstang
10 (4) een einde maakt aan de interfererende functie.

8. Bodemsondeerinrichting (1) volgens conclusie 6 of 7, **met het kenmerk, dat** de communicatie-interfererende middelen (10) zodanig functioneren dat communicatie tussen de eerste
15 communicatiemiddelen (6) van de stangsecties (3) in de sondeerstang (4) anders dan de laatste stangsectie (3a) en de tweede communicatiemiddelen (7) wordt voorkomen.

9. Bodemsondeerinrichting (1) volgens één der conclusies 6-8, **met het kenmerk, dat** de communicatie-interfererende middelen (10) een
20 buisvormige uitstrekking (12) van de stangsectie (3) omvatten.

10. Bodemsondeerinrichting (1) volgens één der conclusies 6-9, **met het kenmerk, dat** de stangsecties (3) een binnenste buis (13)
25 omvattende de eerste communicatiemiddelen (6) en een buitenste buis (14) omvattende de communicatie-interfererende middelen (10) omvatten.



FIG. 1

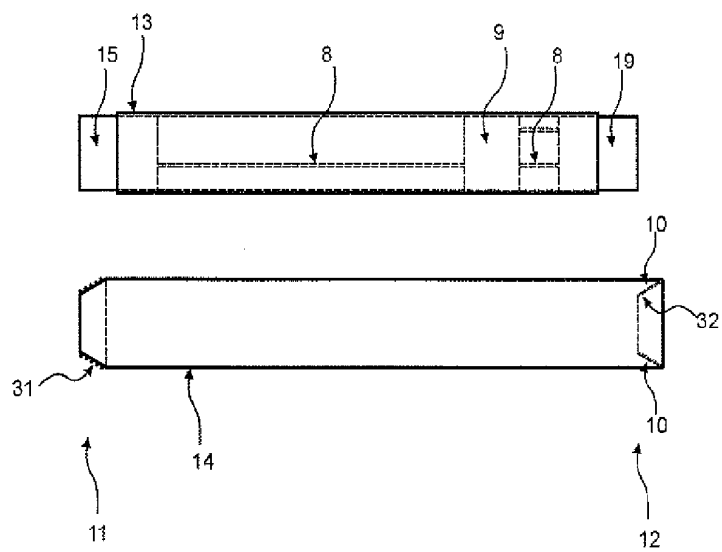


FIG. 2



OCTROOICENTRUM NEDERLAND

OCTROOIAANVRAAG NR.:

NO 136611

NL 2002608

ONDERZOEKSRAPPORT

BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK

RELEVANTE LITERATUUR			
Categorie ¹	Literatuur met, voor zover nodig, aanduiding van speciaal van belang zijnde tekstgedeelten of figuren.	Van belang voor conclusie(s) nr.	Classificatie (IPC)
Y	US 2005/285751 A1 (HALL DAVID R [US] ET AL) 29 december 2005 (2005-12-29) * alineas [0033] - [0039]; figuren 1-4 *	1-10	INV. G01N33/24 E21B47/12 E02D1/00
Y	US 2006/196664 A1 (HALL DAVID R [US] ET AL) 7 september 2006 (2006-09-07) * alinea [0022] *	1-10	
A	US 6 670 880 B1 (HALL DAVID R [US] ET AL) 30 december 2003 (2003-12-30) * het gehele document *	1-10	
A	US 6 487 920 B1 (ROBBAT JR ALBERT [US]) 3 december 2002 (2002-12-03) * kolom 7, regels 14-32; figuren 1-4 *	1-10	
A	US 2007/131025 A1 (KINAST JOHN A [US] ET AL) 14 juni 2007 (2007-06-14) * figuren 2-7 *	1-10	
			Onderzochte gebieden van de techniek
			E21B G01N E02D
Indien gewijzigde conclusies zijn ingediend, heeft dit rapport betrekking op de conclusies ingediend op:			
Plaats van onderzoek: 's-Gravenhage		Datum waarop het onderzoek werd voltooid: 3 November 2009	Bevoegd ambtenaar: Leroux, Corentine
¹ CATEGORIE VAN DE VERMELDE LITERATUUR			
X: de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur Y: de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht A: niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft O: niet-schriftelijke stand van de techniek P: tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur T: na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvraag, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding E: eerdere octrooi(aanvraag), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven D: in de octrooiaanvraag vermeld L: om andere redenen vermelde literatuur & lid van dezelfde octrooifamilie of overeenkomstige octrooi-publicatie			

**AANHANGSEL BEHORENDE BIJ HET RAPPORT BETREFFENDE
HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK,
UITGEVOERD IN DE OCTROOIAANVRAGE NR.**

NO 136611
NL 2002608

Het aanhangsel bevat een opgave van elders gepubliceerde octrooiaanvragen of octrooien (zogenaamde leden van dezelfde octrooifamilie), die overeenkomen met octrooischriften genoemd in het rapport.

De opgave is samengesteld aan de hand van gegevens uit het computerbestand van het Europees Octrooibureau per
De juistheid en volledigheid van deze opgave wordt noch door het Europees Octrooibureau, noch door het Bureau voor de Industriële eigendom gegarandeerd; de gegevens worden verstrekt voor informatiedoeleinden.

03-11-2009

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 2005285751 A1	29-12-2005	US 2006062249 A1	23-03-2006
US 2006196664 A1	07-09-2006	CA 2537463 A1 EP 1698961 A1	01-09-2006 06-09-2006
US 6670880 B1	30-12-2003	AT 427408 T	15-04-2009
US 6487920 B1	03-12-2002	GEEN	
US 2007131025 A1	14-06-2007	GEEN	



OCTROOICENTRUM NEDERLAND

SCHRIFTELIJKE OPINIE

DOSSIER NUMMER NO136611	INDIENINGSDATUM 10.03.2009	VOORRANGSDATUM	AANVRAAGNUMMER NL2002608
CLASSIFICATIE INV. G01N33/24 E21B47/12 E02D1/00			
AANVRAGER A.P. van den Berg Holding B.V. te Heerenveen			

Deze schriftelijke opinie bevat een toelichting op de volgende onderdelen:

- ☒ Onderdeel I Basis van de schriftelijke opinie
- ☐ Onderdeel II Voorrang
- ☐ Onderdeel III Vaststelling nieuwheid, inventiviteit en industriële toepasbaarheid niet mogelijk
- ☐ Onderdeel IV De aanvraag heeft betrekking op meer dan één uitvinding
- ☒ Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid
- ☐ Onderdeel VI Andere geciteerde documenten
- ☐ Onderdeel VII Overige gebreken
- ☐ Onderdeel VIII Overige opmerkingen

DE BEVOEGDE AMBTENAAR Leroux, Corentine
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SCHRIFTELIJKE OPINIE

Aanvraag nr.:
NL2002608

Onderdeel I Basis van de Schriftelijke Opinie

1. Deze schriftelijke opinie is opgesteld op basis van de meest recente conclusies ingediend voor aanvang van het onderzoek.
2. Met betrekking tot **nucleotide en/of aminozuur sequenties** die genoemd worden in de aanvraag en relevant zijn voor de uitvinding zoals beschreven in de conclusies, is dit onderzoek gedaan op basis van:
 - a. type materiaal:
 - ☐ sequentie opsomming
 - ☐ tabel met betrekking tot de sequentie lijst
 - b. vorm van het materiaal:
 - ☐ op papier
 - ☐ in elektronische vorm
 - c. moment van indiening/aanlevering:
 - ☐ opgenomen in de aanvraag zoals ingediend
 - ☐ samen met de aanvraag elektronisch ingediend
 - ☐ later aangeleverd voor het onderzoek
3. ☐ In geval er meer dan één versie of kopie van een sequentie opsomming of tabel met betrekking op een sequentie is ingediend of aangeleverd, zijn de benodigde verklaringen ingediend dat de informatie in de latere of additionele kopieën identiek is aan de aanvraag zoals ingediend of niet meer informatie bevatten dan de aanvraag zoals oorspronkelijk werd ingediend.
4. Overige opmerkingen:

SCHRIFTELIJKE OPINIE

Aanvraag nr.:
NL2002608

Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid

1. Verklaring

Nieuwheid	Ja: Conclusies 1-10 Nee: Conclusies
Inventiviteit	Ja: Conclusies Nee: Conclusies 1-10
Industriële toepasbaarheid	Ja: Conclusies 1-10 Nee: Conclusies

2. Citaties en toelichting:

Zie aparte bladzijde

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

- 1 Reference is made to the following documents:

D1 : US-2005/0285751-A

D2 : US-2006/0196664-A

2 INDEPENDENT CLAIM 1

- 2.1 **D1** is regarded as being the closest prior art to the subject-matter of claim 1 and discloses (cf. relevant passages cited in the search report) a "bodemondeerinrichting omvattende een meetsonde (44), een pluraliteit aan stangsecties (16,18) en een basiseenheid (26)" wherein the "stangsecties" are suitable "voor de schikking van een sondeerstang (14) omvattende de meetsonde", and the "sondeerstang, terwijl deze in de bodem wordt gedrukt elke keer door een of meer stangsecties verlengbar ist".

Furthermore, in this known "bodemondeerinrichting", "elke stangsectie eerste communicatiemiddelen (24a-d) omvat voor draadloze communicatie tussen de opeenvolgende stangsecties in de sondeerstang en de basiseenheid (26) tweede communicatiemiddelen omvat voor communicatie met de eerste communicatiemiddelen van de laatste stangsectie (18a) van de sondeerstang".

- 2.2 The subject-matter of claim 1 therefore differs from this known "bodemondeerinrichting" in that the "tweede communicatiemiddelen" are for "**draadloze** communicatie".

- 2.3 However, these features have already been employed for the same purpose in a similar "bodemondeerinrichting", see document **D2**, par.[0022]). It would be obvious to the person skilled in the art, namely when the same result is to be achieved, to apply these features with corresponding effect to a "bodemondeerinrichting" according to document D1, thereby arriving at a "bodemondeerinrichting" according to claim 1. The subject-matter of claim 1 seems therefore to lack an inventive step.

3 DEPENDENT CLAIMS 2-10

The additional features of dependent claims 2-3, resp. 4, resp. 5 and resp. 6-10 differ from each other and do not solve the same problem, which makes it unclear to determine whether the requirements of unity of invention are met or not. They have therefore been considered as light constructional changes in the "inrichting" of claim 1, which changes seem to come within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen, and which constructional changes have further no surprising effect in combination (cf. also documents cited in the search report). The subject matter of these claims seems not to support an inventive step either.