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(54) DEVICE AND METHOD FOR SENSING A PARAMETER RELATED TO A POSITION OF A DISPLACEABLE ELEMENT IN A ROCK DRILL

VORRICHTUNG UND VERFAHREN ZUR ERFASSUNG EINES PARAMETERS IN BEZUG AUF DIE POSITION EINES VERSCHIEBBAREN ELEMENTS IN EINEM STEINBOHRER

DISPOSITIF ET PROCÉDÉ PERMETTANT LA DÉTECTION D UN PARAMÈTRE ASSOCIÉ À UNE POSITION D UN ÉLÉMENT MOBILE DANS UN PERFORATEUR MÉCANIQUE

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Description

FIELD OF THE INVENTION

[0001] The invention concerns a rock drill sensing device for sensing a parameter in respect of a rock drilling machine according to the preamble of claim 1, and a method according to the preamble of claim 13.

BACKGROUND OF THE INVENTION

[0002] Such a device is previously known from WO 02/090057. In particular, in Fig. 5 of said document is disclosed an arrangement with a sensor coil surrounding the percussion piston in order to indicate changes in the magnetic field caused by movement of the piston.

[0003] Changes of movement of the piston can be roughly determined by the known device. Recent developments in percussive rock drilling machines are however, more and more equipped with possibilities of fine tuning and control, which calls for more accurate indication of the position of a displaceable element in the rock drilling machine.

[0004] US 2007/0114062 A1 relates to a drill bit assembly with a down the hole logging device. GB 2328635 A relates to an impact screwdriver with means to detect strikes.

AIM AND MOST IMPORTANT FEATURES OF THE INVENTION

[0005] For that reason it is an aim with the present invention to provide a device as above, wherein the drawbacks of the prior art are reduced.

[0006] This aim is obtained through the features of the characterizing portion of claim 1. By using an RF (Radio Frequency) sensor element, it has been possible to provide a sensing device which is robust, is insensitive to high pressures, is capable of working with high frequencies and is capable of being used in an environment including air as well as oil. This is a great and unexpected advantage, since the environment where the sensor element is intended to be used, conditions prevail that are considered harmful for electronic equipment in general.

[0007] Further, with a device according to claim 1 it is possible to obtain an absolute value of the position of the displaceable element, which is a great advantages, since it gives the user the possibilities of accurate control of various functions in the rock drilling machine. When it comes to the parameter which is related to a position of the displaceable element, the RF sensor element can be said to be arranged to work as an antenna, whereby the displaceable element influences the RF field of the RF sensor element in dependence of their relative position and/or relative speed. The position of the displaceable element can therefore, according to the invention, be very accurately linked to a parameter signal emanating from the RF sensor element which parameter signal can be of different nature and thus be said to depend on i.a. the nature of the signal or signals supplied to the RF sensor element. Such a parameter signal could for example be a resonance frequency of an RF sensor element resonance circuit, since such a resonance frequency would depend on structures adjacent to the RF sensor element. Such a structure could indeed be the displaceable element.

[0008] By the sensor element being positioned adjacent to and along a path of movement of the displaceable element, accurate sensing and response to movement of the displaceable element is obtained. Preferably the sensor element is positioned sideways of said path of movement.

[0009] In particular, the sensor element extends in the axial direction, which is the direction of displacement, in order to obtain accurate response.

[0010] In particular, the RF-sensor element could be of capacitive type, whereby the sensor element could be adapted to react to an electrical permittivity of an adjacent object.

[0011] In particular further, the the RF-sensor element could be of inductive type, whereby the sensor element could be adapted to react to a magnetic susceptibility of an adjacent object.

[0012] In particular also the RF-sensor element is a coil sensor element whereby good resolution is obtained.

[0013] It is particularly preferred that the coil sensor element has loops inside one another and hereby receives a configuration of a part of a spiral with at least one continuous conductor. With "spiral" is here intended all configurations of conductors having loops inside one another and where the resulting sensor element is essentially flat. It is however within the scope of the invention that the sensor element can be curved.

[0014] Particularly preferred is that the loops include straight portions, in particularly that straight portions extend in said axial direction, i.e. the direction of the displacement of the displaceable element.

[0015] The sensor element can thus be curve-formed, in particular in order to correspond to a form of said housing part, but for simplicity of manufacture it is preferred that the sensor element is flat, which in this case relates to the sensor element per se.

[0016] In particular, the sensor element takes up only a portion of the circumference of the housing part, which makes it possible on the one hand to save space, on the other hand to avoid obstructing other functions of the rock drilling machine, which are likely to be positioned in the housing part in question.

[0017] When the sensor element is formed from a printed circuit, it is particularly economically advantageous to manufacture and to handle and to provide with a desired shape. It is also space saving.

[0018] In particularly the sensor element is integrated in a block of base material such as a synthetic resin, whereby the completed block preferably has been given a shape complementary to a cavity in the housing part.

[0019] The displaceable element is preferably one from the group a percussive piston, a damper piston, a valve spool of a rock drilling machine, since the invention has particular advantage in such applications.

[0020] It is preferred that the sensor element co-operates with an extreme end of the displaceable element for sensing purposes, which gives particularly good response. It is, however, possible and possibly space saving in certain applications when the sensor element co-operates with an intermediate portion of the displaceable element having a deviating dimension for sensing purposes. Such an intermediate portion could for example be a land of the piston having greater diameter than an adjacent part of the piston.

[0021] It is particularly preferred that the sensor element has such an extension in directions of displacement of the displaceable element that it corresponds to the length of travel of the displaceable element.

[0022] Most preferred is that the length of the sensor element exceeds the length of travel of the displaceable element and that both extreme end positions of the displaceable elements are well within the extension of the sensor element. This results in the possibility of having a linear output relation signal/displacement.

[0023] Concerning a suitable sensor device for use herein, it is referred to the position sensor described in US6984994B2.

[0024] The device according to the invention preferably includes an RF oscillator, means for transmitting an input signal or signals to the sensor element from the RF oscillator, means for receiving an output signal or signals from the sensor element and an evaluating means for evaluating the parameter related to the position of the displaceable element based on said output signal or signals. The result of the evaluation could be displayed for an operator, be stored and/or be used to control various functions of the rock drilling machine.

[0025] Preferably, the evaluation means is adapted to evaluate the parameter related to the position of the displaceable element wherein the parameter includes a frequency of the input signal or signals to the sensor element at resonance.

[0026] Preferably, the evaluation means (8) is adapted to evaluate the parameter related to the position of the displaceable element wherein the parameter includes an amplitude of the input signal or signals to the sensor element at resonance.

[0027] Corresponding advantages are obtained in a method, in a rock drilling arrangement, which include such a device and in respect of a sensor element being included in such a device.

BRIEF DESCRIPTION OF DRAWINGS

[0028] The invention will now be described in greater detail by way of embodiments and with reference to the annexed drawings, wherein:

Fig. 1 diagrammatically shows a rock drilling arrangement including a rock drilling machine and a device according to the invention,

Fig. 2 shows a detail of a rock drilling arrangement according to the invention,

Fig. 3 shows the detail in Fig. 2 in an axial section,

Fig. 4 shows a sensor block,

Fig. 5 shows diagrammatically an RF sensor element according to the invention,

Fig. 6 shows a diagram illustrating a signal emanating from the RF sensor element as a function of displacement distance,

Fig. 7a and b show alternative embodiments of the invention,

Fig. 8a shows another embodiment of the invention in respect of a valve device, and

Fig. 8b shows a part of the valve device of Fig. 8a in an enlarged scale.

DESCRIPTION OF EMBODIMENTS

[0029] In Fig. 1 is diagrammatically illustrated a rock drilling machine having a housing 1, wherein, in an axial bore, a displaceable element in the form of an impact piston 2 is moveable to and fro. The piston 2 is arranged in operation to impact a tool 3 or an intermediate impact receiving element which is coupled to a tool (not shown).

[0030] In the region of an extreme (rear) end edge 5 of the piston 2 is positioned a sensor element 4 which extends sideways of and along the path of movement of the piston 2 in the axial direction at the side of the piston and adjacent to the piston 2 travel path.

[0031] The sensor element 4 is over a signal cable 6 connected to an RF circuit 7, which includes an RF oscillator, means for transmitting RF signals to the sensor element 4 and means for receiving output signals from the sensor element 4. 8 indicates a central processing unit (CPU) which i.a. includes circuit or program means for evaluating the signals received from the sensor element 4 in order to thereby establish the present position of the piston 2 in the axial direction thereof.

[0032] More particularly, the sensor element 4 can together with the RF circuit 7 be adapted to radiate an RF field. The optimum or resonance frequency of this field would i.a. depend on the constituents and type of the sensor element 4, but also on electromagnetic properties of elements in the vicinity of the sensor element 4, which elements are subjected to the RF-field. In fig. 1, one such element would be the piston 2. If such an element would change position slightly, the electromagnetic properties of the surroundings, as experienced by the sensor element, would also change and induce a change in the RF-field at resonance. The change in the RF-field could manifest itself as a change in amplitude and/or frequency of the RF-field at *resonance.* Thus, a certain position of the piston 2 could accurately be correlated to the frequency and/or the amplitude of the RF-field at resonance. In fact, it can be shown that resonance frequency is related to a

real part of a complex electromagnetic parameter for a material in the vicinity of the sensor element. Further, resonance amplitude is similarly related to an imaginary part of a complex electromagnetic parameter for a material in the vicinity of the sensor element. Such a complex electromagnetic parameter could for instance be the magnetic susceptibility or the electrical permittivity of a material. The sensor element 4 could be made sensitive to the magnetic susceptibility by being a sensor element of inductive type, such as a coil. Likewise, the sensor element 4 could be made sensitive to the electrical permittivity by being a sensor element of capacitive type. To summarize, there are four electromagnetic properties of objects that can be used in determining a position of such an object, e.g. a piston 2, as described above.

[0033] A PC 9 is shown having a keyboard 10 and a screen 11. An operator can study results from said evaluation on that screen in order to possibly take adequate measures for adjusting any appropriate function of the rock drilling machine.

[0034] According to the invention it is also possible that the CPU 8 is capable of influencing different functions of a drilling rig over outputs 25. Hereby for example feed pressure, percussion pressure etc. can be influenced. In the shown embodiment in Fig. 1 is illustrated a connection between the CPU 8 and a valve device 12 indicating that the CPU is capable of controlling said valve device 12.

[0035] The valve device 12 is, as usual, arranged to distribute percussion pressure to different pressure chambers of the rock drilling machine. The arrangement is per se previously known from rock drilling machines put on the market by the applicant and is therefore not discussed further here.

[0036] Fig. 2 shows a part 13 of the housing of the rock drilling machine as seen in Fig. 1, wherein is illustrated the sensor element 4 being positioned in a cavity in the housing part. A number of bolt holes, two illustrated with 14, are bored in a flange portion of the housing part 13 in order to securely fix the housing part 13 to the rest of the rock drilling machine housing.

[0037] A moulded block 24 is shown including the sensor element 4 and being complementary to the cavity in the housing part.

[0038] In Fig. 3 is illustrated, in an axial section of the housing part 13, the sensor element 4 which has an extension L in the axial direction of the piston 2 in Fig. 1. I.e. in the direction of displacement of the displaceable element the length L of the sensor element exceeds the length of travel, which in Fig. 3 is indicated with 1, between the interrupted lines in Fig. 3. Thus, Fig. 3 shows that the length of travel of the extreme end 5 (in Fig. 1), which is the portion of the displaceable element co-operating with sensor element 4, is well inside the extension of the sensor element 4.

[0039] Fig. 4 shows a cut perspective view of a sensor element 4 which is moulded into a block 24 of synthetic resin, such that the entire block receives a shape which is on the one hand complementary to a cavity in the housing portion where it is to be positioned, on the other hand has a curved portion 25 which corresponds to the inner curvature of said housing part directed radially against the displaceable element. See the corresponding elements in Fig. 2.

[0040] Fig. 5 shows isolated, in more detail, the coil part of the sensor element 4 with portions 15 and 16. In Fig. 5 is shown the RF sensor element 4 in the form of the conductive portions of a printed circuit board (indicated with interrupted lines) having a printed coil being comprised of conductive portions 15 in a direction of travel of a displaceable element and interconnecting conductive portions 16 in directions transverse to the direction of travel. The configuration is thus a part of a spiral-like "curve".

[0041] It is not excluded that two or more continuous conductors are positioned inside one another to form the sensor element.

[0042] In Fig. 6 is shown a curve 17 illustrating a signal emanating from the sensor element 4 as a function of distance of displacement of the displaceable element. With interrupted lines is indicated an essentially linear portion 18 of said curve inside the most extreme length of travel 1 of the displaceable element. The fact that the output is close to linear simplifies signal processing.

[0043] In Fig. 7a and b are shown variants which are, however, not particularly preferred, wherein a coil sensor element which is illustrated with 4' is arranged to be arranged inside a bore of (Fig 7a) or to surround (Fig 7b) the displaceable element 2' at an extreme end thereof. Although these solutions can provide good sensitivity, they have the disadvantages of not giving linear response to displacements and being relatively space consuming.

[0044] Further, such solutions call for rather radical constructional interfering measures as compared to the solution discussed with respect of Figs. 1 - 6, wherein relatively minor constructional measures have to be taken in order to be integrated in a rock drilling machine. 7' in Fig. 7 illustrates an RF circuit adapted to co-operate with the sensor element 4'.

[0045] One solution which could be seen as a hybrid between the embodiment in Figs 1 - 5 and the embodiment in Fig 7a is to provide a sensor element configured as the one in Fig 5 on a rod protruding into a rear piston cavity as in Fig 7a. Hereby no interference with the machine housing radially outside the piston is necessary.

[0046] Fig. 8a shows a valve device 12' having a housing 21 and a valve spool 20 which is movable to and fro. The part of the valve device 12' essentially inside an interrupted line ring in Fig. 8a is shown in a larger scale in Fig. 8b, where a sensor element is illustrated with 4".

[0047] The sensor element 4" is basically constructed in the same way as the sensor element 4 in Figs. 1 - 5 and co-operates with an extreme end edge 19 of the valve spool for sensing purposes. The sensor element 4" is positioned in a particular cavity which is arranged in a valve housing part 22 being fastened to the rest of the valve housing 21. The sensor element 4" can be con-

nected to RF circuits and a CPU in a manner corresponding to what is described with respect to Fig. 1.

[0048] By being able to monitor exactly the position of the valve spool 20 it is possible to more precisely control the valve device 12' and thereby the operation of a rock drilling machine wherein it is intended to be installed.

[0049] The invention gives many advantages when compared to the prior art by being robust, insensitive to high pressures, being able to function at high frequencies and being useable in a hostile environment including air as well as oil and a mix thereof.

[0050] The device according to the invention gives an absolute value of the present position of the displaceable element which means that calibration problems are minimized. It is possible to construct the sensor element according to the invention such that it can deal with long displacement paths, in particular long lengths of travel of an impact piston.

[0051] The invention gives the possibility of providing information about the actual position of the displaceable element, to monitor stroke length, to monitor impact speed, to monitor the entire movement of the displaceable element, in particular an impact piston. The invention further gives the possibility of monitoring possible reflections of the piston and the possibility of detecting the impact position. Further, the invention makes it possible to control the rock drilling machine in various ways as a response to the obtained information.

[0052] In respect of rock drilling machines the invention can be advantageously used for monitoring also movements of the damper as well as for other displaceable elements in the equipment. For that purpose, the movement of e.g. the damper piston can be sensed according to the invention.

[0053] Electronic circuits being included in the RF circuit can be standard components. The CPU can easily be programmed to be provided with functions so that it can communicate with the RF circuit.

[0054] Tests have been preformed to quantify influence of changes of a distance between the sensor element and the displaceable element to the resolution of the sensor element.

[0055] The conclusion is that a change of 0.1 mm of the distance between the sensor element and the displaceable element was equivalent to 0.1 mm piston displacement resolution in an embodied equipment. Therefore it is considered important to be careful about the positioning of the sensor element in respect of the displaceable element in order to obtain accurate results.

[0056] Embodiments with a surrounding coil have been proven difficult for applications for monitoring piston position with adequate precision but can be useful when an object to be monitored is within a maximal range of 1 - 2 mm from the surrounding coil sensor element.

[0057] The flat "spiral" sensor application is in principle applicable to various different applications, and analyses have confirmed that materials and designs are suitable to withstand environments as hostile as the one prevailing in respect of rock drilling machines without negatively effecting sensor integrity and performance.

[0058] Finally, at least one sensor element, i.e. one or more sensor elements, can be used in respect of the invention.

Claims

1. Rock drill sensor element (4) for sensing a parameter related to a position of an element (2) which is displaceable in an axial direction inside a housing (1) of a rock drilling machine, **characterized in that** it is an RF-sensor element which is formed and adapted to said housing (1) so that, in use, it is positionable adjacent to, along and sideways of a path of movement of the displaceable element (2).

2. Sensor element according to claim 1, **characterized in that** the sensor element (4) is of inductive type.

3. Sensor element according to claim 2, **characterized in that** it is a coil sensor element.

4. Rock drill sensing device for sensing a parameter related to a position of a displaceable element (2) which is movable in an axial direction inside a housing (1) of a rock drilling machine, wherein said device includes a sensor element (4) according to any one of the claims 1 - 3, which is located in a housing part adjacent to and along a path of movement of the displaceable element (2).

5. Device according to claim 4, **characterized in that** the sensor element (4) extends in said axial direction.

6. Device according to claim 4 or 5, **characterized in that** the sensor element is curve-formed and that the curve-form of the sensor element corresponds to a form of said housing part.

7. Device according to any one of the claims 4 - 6, **characterized in that** the sensor element (4) is integrated in a block (24) of a base material such as a resin, which has a shape complementary to a cavity in the housing part.

8. Device according to any one of the claims 4 - 7, **characterized in that** the sensor element (4) co-operates with an extreme end (5) of the displaceable element (2) or with an intermediate portion of the displaceable element having a deviating dimension, for sensing purposes.

9. Device according to any one of the claims 4 - 8, **characterized in that** it includes (7) an RF oscillator, means for transmitting input signal or signals to the sensor element from the RF oscillator, means for

receiving output signal or signals from the sensor element and an evaluation means (8) for evaluating the parameter related to the position of the displaceable element based on said output signal or signals.

10. Device according to claim 9, **characterized in that** the evaluation means (8) is adapted to evaluate the parameter related to the position of the displaceable element wherein the parameter includes a frequency of the input signal or signals to the sensor element at resonance.

11. Device according to claim 9 or 10, **characterized in that** the evaluation means (8) is adapted to evaluate the parameter related to the position of the displaceable element wherein the parameter includes an amplitude of the input signal or signals to the sensor element at resonance.

12. Rock drilling arrangement with a percussive rock drilling machine including a device according to any one of the claims 4 - 11.

13. Method for sensing a parameter related to a position of a displaceable element (2) which is movable in an axial direction inside a housing (1) of a rock drilling machine, wherein is used a sensor element (4) which is located in a housing part, **characterized in that** the sensor element, being an RF sensor element, senses said parameter from a position adjacent to, along and sideways of a path of movement of the displaceable element (2).

14. Method according to claim 13, **characterized in that** the sensor element (4) co-operates with an extreme end (5) of the displaceable element (2) or with an intermediate portion of the displaceable element having a deviating dimension, for sensing purposes.

15. Method according to claim 13 or 14, **characterized in that** RF input signal or signals is/are transmitted to the sensor element and that RF output signal or signals are received from the sensor element and that based on said output signal or signals a parameter related to the position of the displaceable element is evaluated.

Patentansprüche

1. Gesteinsbohrsensorelement (4) zum Erfassen eines Parameters, der sich auf eine Position eines Elements (2) bezieht, das in einer axialen Richtung innerhalb eines Gehäuses (1) einer Gesteinsbohrrnaschine verstellbar ist, **dadurch gekennzeichnet, dass** es ein HF-Sensorelement ist, das so geformt und an das Gehäuse (1) angepasst ist, dass es im Gebrauch angrenzend an einen Weg, entlang und seitlich eines Weges einer Bewegung des verstellbaren Elements (2) positionierbar ist.

2. Sensorelement nach Anspruch 1, **dadurch gekennzeichnet, dass** das Sensorelement (4) von einem induktiven Typ ist.

3. Sensorelement nach Anspruch 2, **dadurch gekennzeichnet, dass** es ein Spulensensorelement ist.

4. Gesteinsbohrerfassungsvorrichtung zum Erfassen eines Parameters, der sich auf eine Position eines verstellbaren Elements (2) bezieht, das in einer axialen Richtung innerhalb eines Gehäuses (1) einer Gesteinsbohrmaschine beweglich ist, wobei die Vorrichtung ein Sensorelement (4) nach einem der Ansprüche 1-3 enthält, das sich in einem Gehäuseteil angrenzend an einen Weg und entlang eines Weges der Bewegung des verstellbaren Elements (2) befindet.

5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** sich das Sensorelement (4) in der axialen Richtung erstreckt.

6. Vorrichtung nach Anspruch 4 oder 5, **dadurch gekennzeichnet, dass** das Sensorelement kurvenförmig ist und dass die Kurvenform des Sensorelements einer Form des Gehäuseteils entspricht.

7. Vorrichtung nach einem der Ansprüche 4-6, **dadurch gekennzeichnet, dass** das Sensorelement (4) in einen Block (24) eines Basismaterials, wie etwa Harz, eingebaut ist, der eine Form besitzt, die zu einem Hohlraum in dem Gehäuseteil komplementär ist.

8. Vorrichtung nach einem der Ansprüche 4-7, **dadurch gekennzeichnet, dass** das Sensorelement (4) mit einem äußersten Ende (5) des verstellbaren Elements (2) oder mit einem Zwischenabschnitt des verstellbaren Elements, der eine abweichende Abmessung besitzt, zum Zweck des Erfassens zusammenarbeitet.

9. Vorrichtung nach einem der Ansprüche 4-8, **dadurch gekennzeichnet, dass** es einen HF-Oszillator (7), Mittel zum Senden eines Eingangssignals oder von Eingangssignalen von dem HF-Oszillator an das Sensorelement, Mittel zum Empfangen eines Ausgangssignals oder von Ausgangssignalen von dem Sensorelement und Bewertungsmittel (8) zum Bewerten des Parameters, der sich auf die Position des verstellbaren Elements bezieht, aufgrund des Ausgangssignals oder der Ausgangssignale, enthält.

10. Vorrichtung nach Anspruch 9, **dadurch gekenn-**

zeichnet, dass die Bewertungsmittel (8) ausgelegt sind, den Parameter zu bewerten, der sich auf die Position des verstellbaren Elements bezieht, wobei der Parameter eine Frequenz des Eingangssignals oder von Eingangssignalen des Sensorelements bei einer Resonanz enthält.

11. Vorrichtung nach Anspruch 9 oder 10, **dadurch gekennzeichnet, dass** die Bewertungsmittel (8) ausgelegt sind, den Parameter zu bewerten, der sich auf die Position des verstellbaren Elements bezieht, wobei der Parameter eine Amplitude des Eingangssignals oder der Eingangssignale des Sensorelements bei einer Resonanz enthält.

12. Gesteinsbohranordnung mit einer Gesteinsschlagbohrmaschine, die eine Vorrichtung nach einem der Ansprüche 4-11 enthält.

13. Verfahren zum Erfassen eines Parameters, der sich auf eine Position eines verstellbaren Elements (2) bezieht, das in einer axialen Richtung innerhalb eines Gehäuses (1) einer Gesteinsbohrmaschine beweglich ist, wobei ein Sensorelement (4) verwendet wird, das sich in einem Gehäuseteil befindet, **dadurch gekennzeichnet, dass** das Sensorelement, das ein HF-Sensorelement ist, den Parameter von einer Position angrenzend an einen Weg, entlang und seitlich eines Weges der Bewegung des verstellbaren Elements (2) erfasst.

14. Verfahren nach Anspruch 13, **dadurch gekennzeichnet, dass** das Sensorelement (4) mit einem äußersten Ende (5) des verstellbaren Elements (2) oder mit einem Zwischenabschnitt des verstellbaren Elements, der eine abweichende Abmessung hat, zum Zweck der Erfassung zusammenarbeitet.

15. Verfahren nach Anspruch 13 oder 14, **dadurch gekennzeichnet, dass** das HF-Eingangssignal oder die HF-Eingangssignale an das Sensorelement gesendet werden und dass das HF-Ausgangssignal oder die HF-Ausgangssignale von dem Sensorelement empfangen werden und dass aufgrund des Ausgangssignal oder der Ausgangssignale ein Parameter, der sich auf die Position des verstellbaren Elements bezieht, bewertet wird.

Revendications

1. Elément de capteur de forage de roche (4) pour détecter un paramètre relatif à une position d'un élément (2) qui est déplaçable dans un sens axial à l'intérieur d'un logement (1) d'un perforateur mécanique, **caractérisé en ce qu'**il s'agit d'un élément de capteur RF qui est formé et adapté audit logement (1) de telle sorte que, durant le service, il puisse être positionné adjacent, longitudinalement et transversalement à une trajectoire de déplacement de l'élément déplaçable (2).

2. Élément de capteur selon la revendication 1, **caractérisé en ce que** l'élément de capteur (4) est du type inductif.

3. Elément de capteur selon la revendication 2, **caractérisé en ce qu'**il s'agit d'un élément de capteur à bobine.

4. Dispositif de détection de forage de roche destiné à détecter un paramètre relatif à une position d'un élément déplaçable (2) qui est déplaçable dans un sens axial à l'intérieur d'un logement (1) d'un perforateur mécanique, ledit dispositif comportant un élément de capteur (4) selon l'une quelconque des revendications 1 à 3, qui est situé dans une pièce de logement adjacent et longitudinalement à une trajectoire de déplacement de l'élément déplaçable (2).

5. Dispositif selon la revendication 4, **caractérisé en ce que** l'élément de capteur (4) s'étend dans ledit sens axial.

6. Dispositif selon la revendication 4 ou 5, **caractérisé en ce que** l'élément de capteur est de forme courbe et la forme courbe de l'élément de capteur correspond à une forme de ladite pièce de logement.

7. Dispositif selon l'une quelconque des revendications 4 à 6, **caractérisé en ce que** l'élément de capteur (4) est intégré dans un bloc (24) d'un matériau de base tel qu'une résine, lequel a une forme complémentaire de celle d'une cavité dans la pièce de logement.

8. Dispositif selon l'une quelconque des revendications 4 à 7, **caractérisé en ce que** l'élément de capteur (4) coopère avec une extrémité (5) de l'élément déplaçable (2) ou avec une partie intermédiaire de l'élément déplaçable ayant une dimension de déviation, aux fins de la détection.

9. Dispositif selon l'une quelconque des revendications 4 à 8, **caractérisé en ce qu'**il comporte (7) un oscillateur RF, un moyen de transmission d'un ou de signaux d'entrée à l'élément de capteur depuis l'oscillateur RF, un moyen de réception d'un ou de signaux de sortie depuis l'élément de capteur et un moyen d'évaluation (8) pour évaluer le paramètre relatif à la position de l'élément déplaçable en fonction du ou des signaux de sortie.

10. Dispositif selon la revendication 9, **caractérisé en ce que** le moyen d'évaluation (8) est adapté pour évaluer le paramètre relatif à la position de l'élément

déplaçable, le paramètre comportant une fréquence du ou des signaux d'entrée allant à l'élément de capteur en état de résonance.

11. Dispositif selon la revendication 9 ou 10, **caractérisé en ce que** le moyen d'évaluation (8) est adapté pour évaluer le paramètre relatif à la position de l'élément déplaçable, le paramètre comportant une amplitude du ou des signaux d'entrée allant à l'élément de capteur en état de résonance.

12. Agencement de forage de roche avec un perforateur mécanique à percussions comportant un dispositif selon l'une quelconque des revendications 4 à 11.

13. Procédé de détection d'un paramètre relatif à une position d'un élément déplaçable (2) qui est déplaçable dans un sens axial à l'intérieur d'un logement (1) d'un perforateur mécanique, dans lequel est utilisé un élément de capteur (4) qui est placé dans une pièce de logement, **caractérisé en ce que** l'élément de capteur, étant un élément de capteur RF, détecte ledit paramètre à partir d'une position adjacente, longitudinale et transversale à une trajectoire de déplacement de l'élément déplaçable (2).

14. Procédé selon la revendication 13, **caractérisé en ce que** l'élément de capteur (4) coopère avec une extrémité (5) de l'élément déplaçable (2) ou avec une partie intermédiaire de l'élément déplaçable ayant une dimension de déviation, aux fins de la détection.

15. Procédé selon la revendication 13 ou 14, **caractérisé en ce qu'**un ou des signaux RF sont transmis à l'élément de capteur et qu'un ou des signaux de sortie sont reçus depuis l'élément de capteur et en fonction du ou des signaux de sortie un paramètre relatif à la position de l'élément déplaçable est évalué.

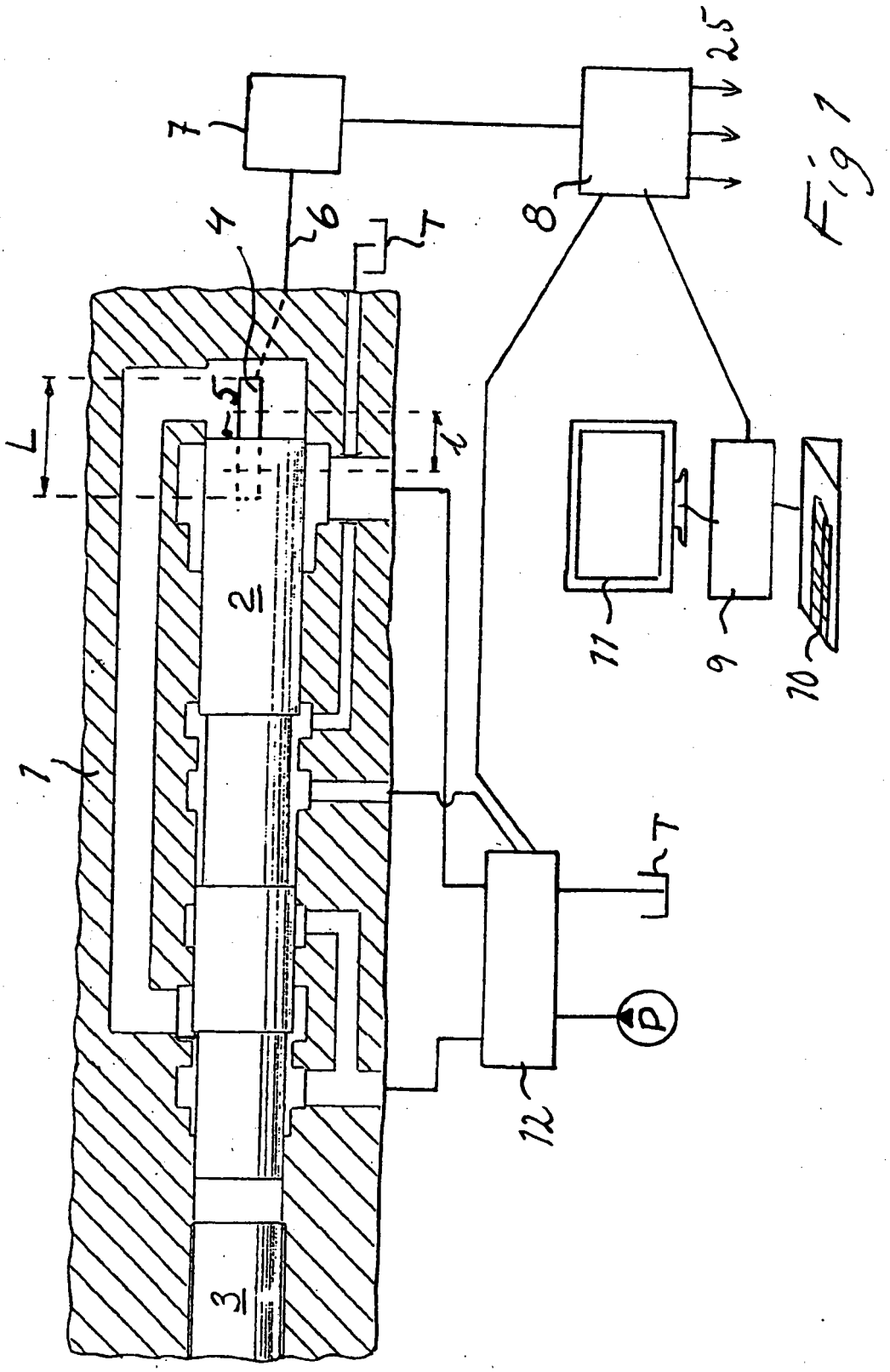

Fig 1

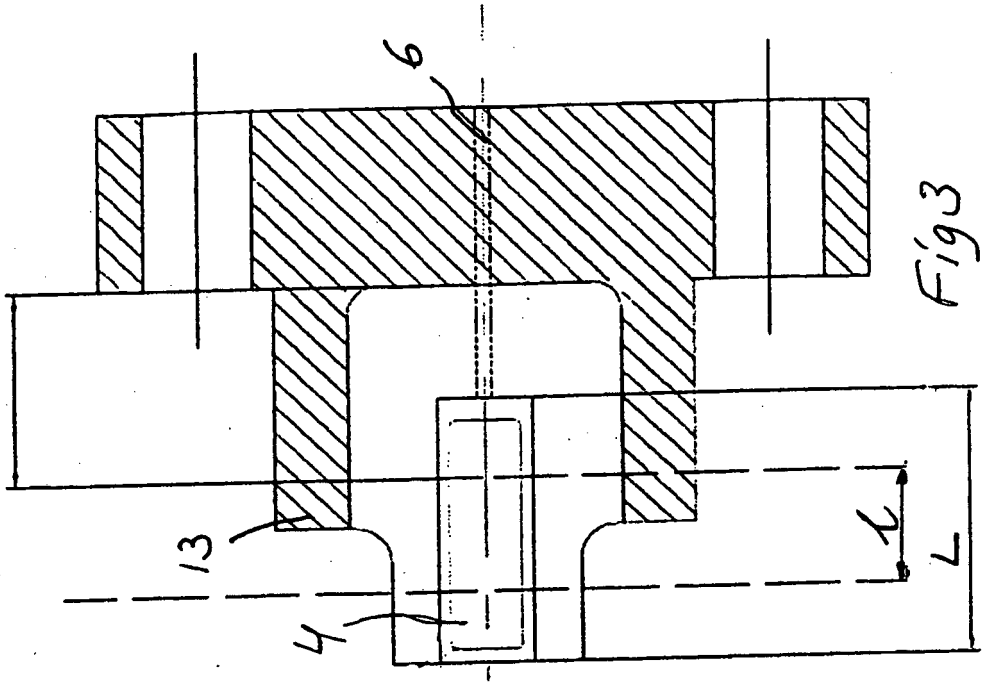

Fig3

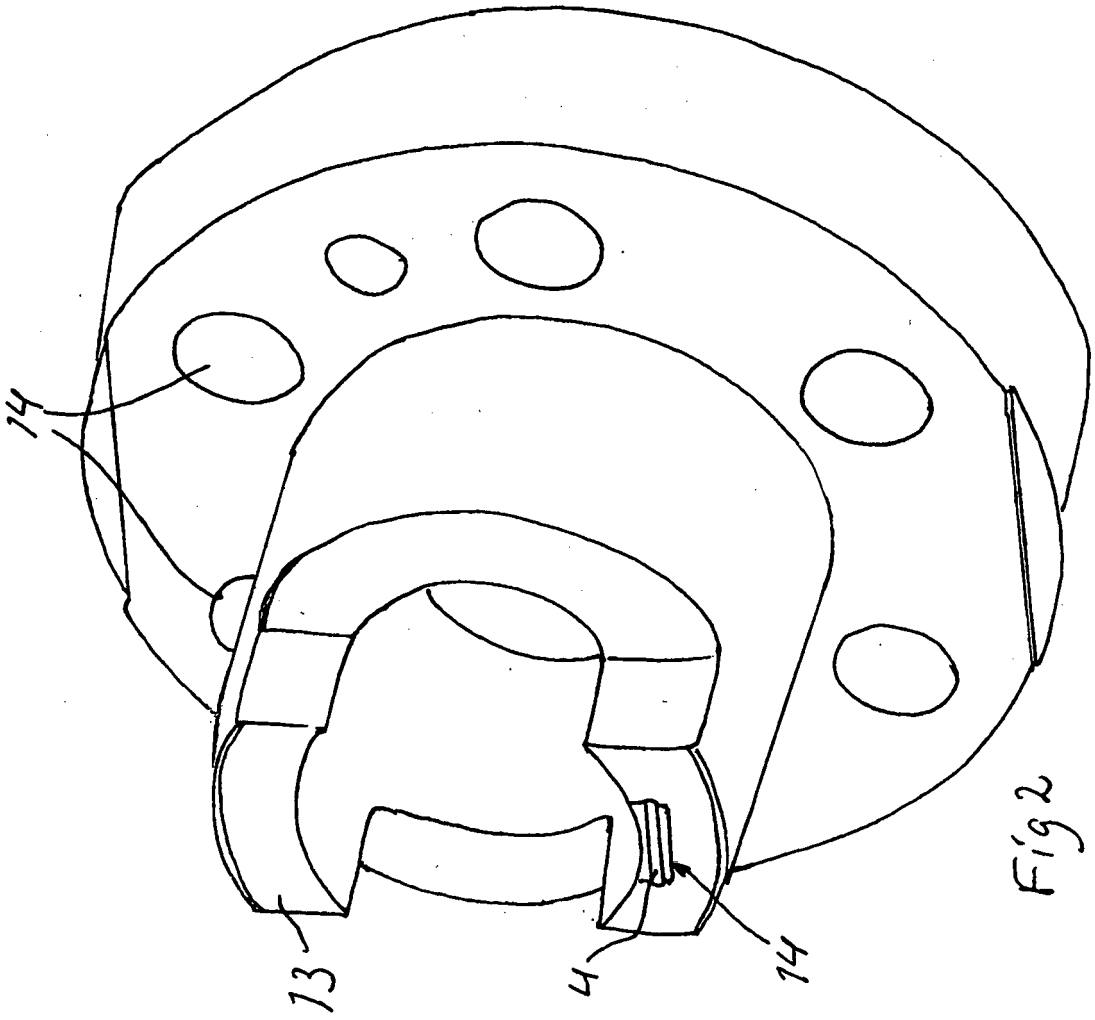

Fig2

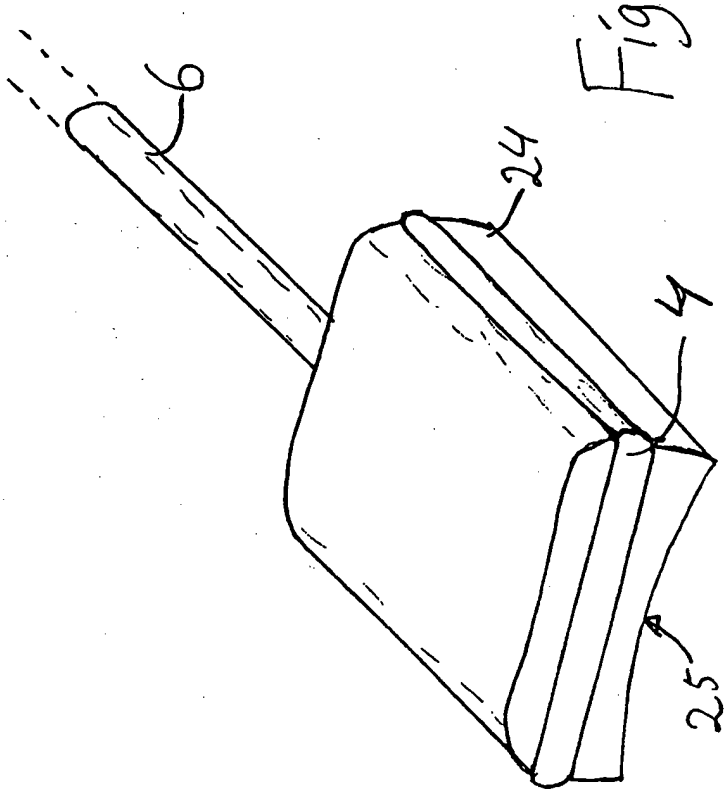

Fig 4

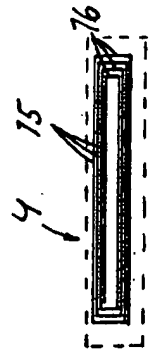

Fig 5

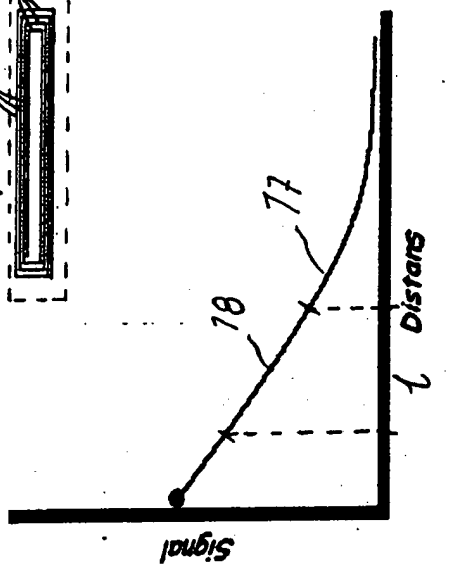

Fig 6

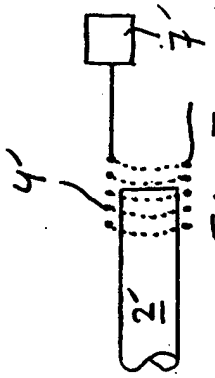

Fig 7b

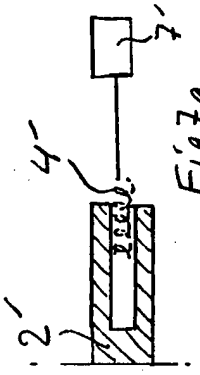

Fig 7a

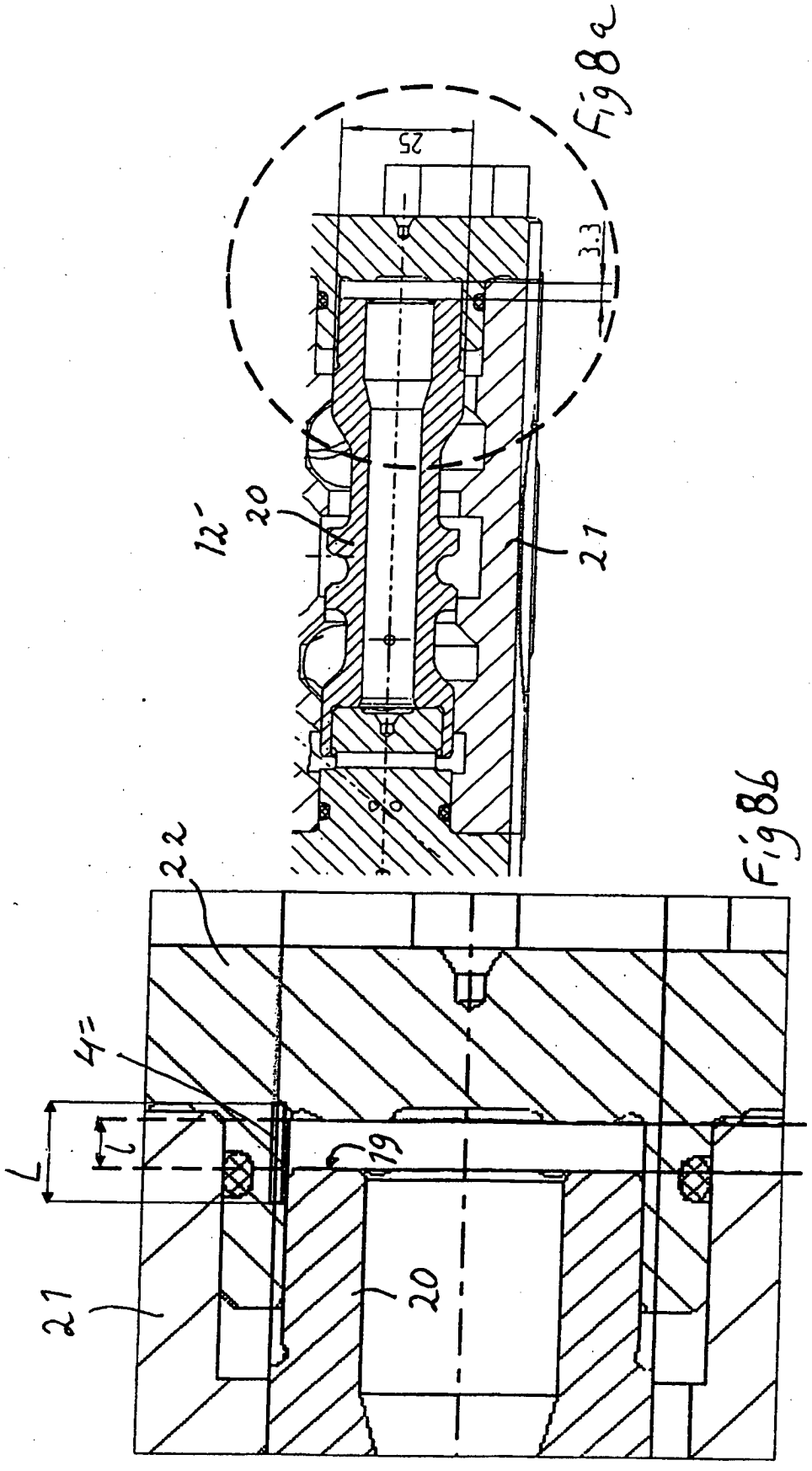
Fig 8a
25
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Fig 8b
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REFERENCES CITED IN THE DESCRIPTION

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