(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 041 395 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
19.04.2017 Bulletin 2017/16

(21) Application number: **07748210.7**

(22) Date of filing: **07.06.2007**

(51) Int Cl.:
E21D 20/00 *(2006.01)* ***E21B 47/09*** *(2012.01)*
E21B 7/02 *(2006.01)*

(86) International application number:
PCT/SE2007/000547

(87) International publication number:
WO 2008/010757 (24.01.2008 Gazette 2008/04)

(54) ARRANGEMENT AND METHOD FOR DETERMINING THE POSITION OF A ROCK REINFORCING BOLT

ANORDNUNG UND VERFAHREN ZUR BESTIMMUNG DER POSITION EINES FELSVERSTÄRKUNGSBOLZENS

PROCÉDÉ ET DISPOSITIF POUR DÉTERMINER LA POSITION D'UN BOULON DE CONSOLIDATION DE ROCHE

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR

(30) Priority: **17.07.2006 SE 0601569**

(43) Date of publication of application:
01.04.2009 Bulletin 2009/14

(73) Proprietor: **Atlas Copco Rock Drills AB**
701 14 Örebro (SE)

(72) Inventor: **GUSTAVSSON, Hans**
703 78 Örebro (SE)

(74) Representative: **Ehrner & Delmar Patentbyrå AB**
Box 10316
100 55 Stockholm (SE)

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Description

Technical field

[0001] The invention relates to a method and an arrangement for determining the position of a rock reinforcing bolt according to the preamble to Claim 1 and Claim 12 respectively. A method and an arrangement according to the preamble of claims 1 resp. 12 are disclosed in US 4158520.

Background art

[0002] Rock reinforcement in tunnels and mines is usually achieved by the installation of a number of rock bolts distributed over the rock surfaces of the tunnel or drift in the walls and roof. If the installation is documented, this is currently often carried out manually by making notes on paper, but it can also be the case that the installation is not documented at all.

[0003] Where documentation is actually carried out, the manual documentation process is however time-consuming and unreliable. It is often difficult to ensure the quality of the reinforcing installation, in particular as, especially in the case of tunnelling, the rock bolts are often covered by so-called shotcrete shortly after installation. In addition, the bolts are seldom installed according to a predetermined plan, but are instead often installed where the operator thinks fit, that is where he considers that reinforcement is required, usually with insufficient documentation of the position of the bolts or no documentation at all.

[0004] This creates problems, as in general the authorities are imposing more and more stringent requirements concerning documentation of reinforcing installations so that, for example, a tunnel project as a whole can be certified in accordance with some suitable certification standard. This means that ever-greater demands are being made that the actual positions of the reinforcement points should be known and well-documented.

[0005] A problem with this documentation is, however, that it can be both difficult and time-consuming to determine the position of the reinforcing bolts with sufficient accuracy. There is thus a need for an improved arrangement for determining the position of rock bolt installations.

Object of the invention and its most important features

[0006] An object of the present invention is to provide a method and an arrangement that make possible accurate and time-saving determination of the position of reinforcing bolt installations and that thereby solves the abovementioned problem.

[0007] This and other objects are achieved according to the present invention by a method as defined in Claim 1, and an arrangement as defined in Claim 12.

[0008] According to the present invention, a method is provided for determining the position of at least one rock reinforcing bolt installation in a tunnel or a mine, in which the bolt installation is arranged to be carried out using a drilling rig, with the said drilling rig comprising at least one boom with a first end and a second end, with the said first end being attached to a carrier via at least one articulated connection, and with the said boom being arranged to carry an installation tool. The method comprises the steps of determining a position for the said carrier by means of devices arranged on the drilling rig, determining at least one angle of rotation for the said boom in relation to the carrier by determination of an angle of rotation for the said articulated connection, and determining the position of the rock reinforcing bolt in the tunnel or mine on the basis of the said position of the carrier and the said determined angle of rotation.

[0009] This has the advantage that the precise position of the rock reinforcing bolt can be determined in a simple way by determination of the position of the installation end of the installation tool, that is the position where the outer end of the bolt is finally located. The position can be stored automatically in, for example, a memory in a computer. By storing the positions of a plurality of the rock reinforcing bolts or the positions of all the rock reinforcing bolts in the tunnel or drift, a list of bolt installations can be drawn up in a simple way which can then be chartered on a map of the tunnel or drift. If, in the future, parts or sections of the walls and/or roof of the tunnel or drift become loose, it can easily be seen on the map that was drawn up which bolt or bolts have been installed in the location in question. A very precise position of the bolt can be determined, as the angle of rotation of the articulated connection of the boom in relation to the carrier is used for the determination of the position of the bolt. In addition, the length of the boom should be used for the determination of the position of the bolt, and if, for example, a boom of a certain length is used, the bolt's "offset" in relation to the carrier can thus be determined, which enables a very accurate determination of the position to be carried out. If the length of the boom is telescopically adjustable, the actual length of the boom at the time of installation is used. In addition, with knowledge of the boom angle, the direction of the installation hole can also be determined, so that the position of the whole length of the bolt can also be determined. In this case, a direction from the installation point is preferably stored, with this direction being able to be specified, for example, with reference to the coordinate system for the tunnel/drift.

[0010] The boom can also be attached to the carrier via more than one articulated connection, with the angle of rotation in relation to the carrier for all these articulated connections being able to be used for determination of the position of the bolt installation. In addition, the bolt installation tool can be arranged on a feeder rod, which can, in turn, be attached to the end of the boom facing away from the carrier via one or more articulated connections, with the angle of rotation for these articulated connections also being able to be used for determination

of the position (and direction) of the bolt.

[0011] Corresponding advantages are achieved with corresponding characteristics of the arrangement.

Brief description of drawings

[0012] The invention will now be described in greater detail in the form of an embodiment and with reference to the attached drawings, in which:

Figure 1 shows schematically a drilling rig according to the present invention.

Figure 2 shows schematically an embodiment according to the present invention.

Detailed description of an exemplary embodiment

[0013] For tunnelling, large drilling rigs are often used, with a carrier comprising a plurality of booms with associated drilling machines. The tunnelling is often carried out a few metres at a time, typically 2-6 metres, with the drilling rig drilling a large number of holes according to a predetermined drilling plan. The length of the holes is normally 2-6 metres, and after the drilling is completed, these are charged with explosives for subsequent blasting. The drilling of these holes takes a long time, and typically a working shift, or an even longer period of time, is completed before the drilling rig needs to be moved for blasting or new drilling. For ore mining, considerably fewer holes are drilled, but, on the other hand, these are considerably longer, up to 50 metres or more, so that in this case a "drilling round" can also take a long time. Thus it is also the case here that the production drilling rig does not need to be moved very often. As it is very important that both tunnelling and ore mining is carried out precisely where it is intended to be carried out, the position of these rigs is measured very precisely before a new round of drilling commences. This measuring is carried out by mine surveyors who carry out precise measuring of the position of the rigs using tacheometers. This measuring is time-consuming, but still only constitutes a small part of the time that the drilling rig remains in the same place.

[0014] Rock reinforcing rigs consist, on the other hand, of considerably smaller rigs that typically do not remain stationary for such a long period of time before they are moved. The time that they remain stationary depends upon how closely the bolts must be set, the length and type of bolt, etc, but the time that they remain stationary can be as little as approximately 30 minutes. During tunnelling, the movement is often sideways or only a short distance forwards, for the insertion of a new rock reinforcing bolt. As mentioned above, the reinforcing bolts are seldom installed according to a predetermined plan, but are instead often installed as the operator sees fit, that is in the places where he considers that reinforcement is required. One of the reasons for this is that determining the position of the rig using a tacheometer takes a long time, and as the rig often needs to be moved after it has been set up for only a short time, determining its position with a tacheometer takes up too great a proportion of the rig's operating time for this to be economical, perhaps of the order of 50% of the time. As also mentioned above, as a result there is often insufficient documentation of the placing of the reinforcing bolts or even no documentation at all.

[0015] The present invention solves this problem with a rock reinforcing rig of the type illustrated in Figure 1. In Figure 1, the number 10 designates in general a drilling rig for the installation of rock reinforcing bolts, for example, for tunnelling or mining. The drilling rig 10 includes a boom 11, one end 11a of which is attached, in such a way that it can pivot, to a carrier 12, such as a vehicle, via one or more articulated connections and on the other end 11b of which is arranged a feeder 13 that carries a bolt installation tool 14. The bolt installation tool 14 can be moved along the feeder 13 and consists at least partially of a drilling machine for drilling holes for reinforcing bolts. In addition, the rig 10 comprises a control unit 16 that is used for determining the position of installed reinforcing bolts according to the present invention by monitoring the position, direction and drilled distance, etc, in relation to the drilling machine and carrier. The control unit 16 can also be used to control the movement of the rig 10. Alternatively, movement of the rig can be carried out by means of a separate control unit. The function according to the present invention can advantageously be implemented in an existing calculating unit arranged in the drilling rig, for example as an integrated part of the control system of the drilling rig. The position of the drilled hole (that is the fixing hole for the reinforcing bolt) in relation to the carrier is determined, according to the invention, by reading off the rotational position of the boom (the rotational position of the articulated connections for the boom) in relation to the carrier and the rotational position of the feeder (the rotational position of the articulated connections for the feeder) in relation to the end of the boom 11 that is facing away from the feeder. By reading off the rotational positions of the articulated connections for the boom and of the articulated connections for the feeder, a very precise determination can be carried out of the position of the tip of the feeder (the end of the feeder that faces towards the rock during drilling), and accordingly a very precise determination of the position of the drilled hole in relation to the carrier. The articulated connections are normally provided with absolute position sensors, whereby, at each point in time, an absolute position for each articulated connection for the boom can be obtained. The use of these absolute position sensors is already known, and will therefore not be described here in greater detail. With known angles of rotation for the articulated connections, the control unit 16 can calculate the position of the tip of the feeder in relation to the carrier by suitable geometric calculations. For this calculation, the length of the boom is also required, which can be stored in a memory in or connected to the control unit. If

the boom length can be adjusted telescopically, the arrangement comprises detectors for determining the increase in length of the boom. In addition, the angle of the feeder can be determined, whereby the direction of the bolt into the rock can also be determined and stored.

[0016] Although the control unit is shown here as being located on the carrier, it can also be located at a distance, in which case the rotational positions of the articulated connections can be sent, for example by wireless means, to the remote location in order for the position/direction of the reinforcing bolts to be calculated there.

[0017] Thus far, the determination of the position of the reinforcing bolt gives the position of the bolt in relation to the carrier, which constitutes a very important part of the present invention, as the combined length of boom and feeder can be considerable, and the distance between two extreme positions can change the position of a bolt considerably compared to when only a rig position is used. In addition, the drilling rig 10 comprises means for determining the position of the rig (the carrier) in the tunnel/mine. These means can, for example, consist of one or more rotating lasers arranged on the carrier, with the rotating laser beam being used to detect reference marks set up in the mine and to determine angles to these reference marks. This is illustrated by Figure 2, where the drilling rig is shown from above. In the figure, the drilling rig comprises a rotating laser 20 and, in addition, three reference marks 21, 22, 23 are shown. These reference marks can, for example, consist of reflectors that have been set up, and their position can have been made available to the control system of the drilling rig when they were set up. The position of the reference marks can advantageously consist of an absolute position, at least in relation to a coordinate system drawn up for the tunnel/mine, so that the position of the carrier that is determined using the position-determining means can be entered directly in a coordinate system and/or on a map of the tunnel/mine. The use of at least three reflectors means that the position-determining means can determine the position of the carrier by means of triangulation. As is realised, triangulation provides position determination in two dimensions. The third dimension (the height) is, however, normally already known, particularly in the case of tunnelling where the tunnel is often drilled in accordance with very strict tolerances concerning its position, and the height of the floor and roof of the tunnel is thus well-known and can be combined with position data according to the invention. In mines, the reflectors can, for example, be coded so that it is apparent in which drift they are set up, whereby the height is obtained by knowledge of the height of the drift in the coordinate system of the mine. This height information can either be available in the drilling rig's control system, or alternatively this combining can be carried out in a remote monitoring centre, to which the rig position data is sent. The present invention has thus the advantage that no external measuring of the position of the rig needs to be carried out, as the rig can handle this itself. In addition, the position can be obtained continuously by means of the rotating laser.

[0018] In order to enable an accurate determination of the position of the carrier to be carried out, the position of the reflectors can advantageously be determined using a tacheometer. The range of the rotating laser for position determination is of the order of 40 metres, which means that, particularly for tunnelling, reflectors that have been set up can be used for rapid determination of the position of the drilling rig for a long period of time, such as a whole shift or even several days, before one or more new or moved reflectors are required for the position determination. In addition to knowledge of the position of the rig, the rig's angle of inclination should also be determined in a longitudinal and/or lateral direction, as this inclination will affect the direction of the boom and hence the determination of the position of the reinforcing bolt. This inclination of the carrier can, for example, be determined by the carrier comprising an inclination sensor such as a gyro.

[0019] Taken as a whole, a very good determination of the position of the bolt can thus be carried out, and as this position determination is carried out by a control unit, it can be stored directly in a memory in the drilling rig, for example together with the type of bolt. Alternatively, the position can be sent to a remote centre designed for the collection of data. By this means, it is possible to monitor and document installations carried out by not only one but also several rigs in a tunnel or mine or in several tunnels or mines. This transmission can, for example, be arranged to be carried out by wireless means via some existing system for wireless communication in the mine, such as, for example, by means of a WLAN or a mobile communication system. The transmission can be IP-based (Internet Protocol-based). By subsequently entering the determined positions of the bolts on a map of the mine/tunnel or in a coordinate system, a list of the reinforcing bolts installed in the tunnel/mine can be drawn up in a simple way.

[0020] The invention can also be used for installing reinforcing bolts in accordance with a predetermined plan, for example in order to ensure that an adequate number of bolts are installed per unit of area. By the use of suitable software, it is also possible to support the installation on site by the provision of position information from a memory for display to an operator, or for automatic control of the process, for example from a remote location.

[0021] In addition, by the use of suitable software, it is possible, for example, to display the reinforcements that have been carried out in a specific tunnel or mine in various formats, for example in 3D on a monitor.

[0022] In addition to the position of the bolt, other bolt installation data can also be stored with the position of the bolt. In the case of an expanding tubular bolt that is expanded by means of pressurized fluid, such data can, for example, consist of: maximum pressure attained during the expansion, duration of the expansion time above a predetermined pressure level, bolt tension, type, length, diameter of the bolt and, where appropriate, vol-

ume of securing injection mortar.

[0023] For a normal rock reinforcing bolt that can have, for example, mechanical means such as a threaded expansion device, or no expansion device at all, here called non-tubular bolts, the installation parameters are: expansion tension, bolt tension, type, length, diameter of the bolt and, where appropriate, volume of securing injection mortar. For other types of bolt, it can be of interest to log other parameters.

[0024] In the above description, the position determination system on the carrier has been described as a laser system that detects reflectors. It is possible, however, within the scope of the present invention, to use any system by means of which a good determination of the position of the drilling rig can be carried out from the rig. For example, radio transmitters can be used for triangulation using signals received from these transmitters, in which case directional antennas are preferably used for determination of the direction of the transmitters in relation to the carrier.

[0025] In addition, in the above description, the boom consists of a boom of fixed length or a boom with telescopically-adjustable length. The installation tool can, however, also be attached to the carrier via two or more articulated boom sections. Such an arrangement can, for example, be used to provide increased manoeuvrability in tight spaces, and in this case the rotational position of the said boom sections in relation to each other is also used for the determination of the position of the bolt, which rotational position is preferably determined by determination of at least one angle of rotation for the articulated connection or connections that connect the said sections of the boom.

Claims

1. Method for determining the position of at least one rock reinforcing bolt in a tunnel or a mine, with the bolt installation being arranged to be carried out by means of a drilling rig (10), with the said drilling rig (10) comprising at least one boom (11) with a first end and a second end, with the said first end being attached to a carrier (12) via at least one articulated connection, and with the said boom (11) being arranged to carry an installation tool (14), **characterized in that** the method comprises the steps of:

   - determining a position for the said carrier (12) using means arranged on the drilling rig (10),
   - determining at least one angle for the said boom (11) in relation to the carrier (12) by determination of an angle of rotation for the said articulated connection, and
   - determining the position of the rock reinforcing bolt in the tunnel or mine on the basis of the said position of the carrier (12) and the said determined angle of rotation.

2. Method according to Claim 1, with the position of the rock reinforcing bolt being determined on the basis of a length of the said boom (11).

3. Method according to Claim 1 or 2, with the method comprising, in addition, the step of determining a direction for the said reinforcing bolt.

4. Method according to any one of Claims 1-3, **characterized in that** the said determination of a position for the said carrier (12) comprises determination of the directions to at least three reference points.

5. Method according to Claim 4, in which the said determination of direction is carried out by means of at least one rotating laser or at least one directional antenna.

6. Method according to any one of the preceding claims, **characterized in that** the said determination of the position of the bolt comprises, in addition, the determination of the inclination of the carrier (12) in a lateral and/or longitudinal direction.

7. Method according to any one of the preceding claims, **characterized in that**, in addition, it comprises the step of storing the said position of the bolt in a memory.

8. Method according to any one of the preceding claims, **characterized in that**, in addition, it comprises the step of storing the positions of a plurality of reinforcing bolts in a memory.

9. Method according to any one of the preceding claims, **characterized in that**, in addition, it comprises the step of converting stored data into a form that can be displayed visually.

10. Method according to any one of the preceding claims, **characterized in that**, in addition, it comprises the step of transmitting the said determined position of the bolt to a remote location.

11. Method according to any one of the preceding claims, **characterized in that** the said boom (11) consists of at least two articulated boom sections, with at least one angle of the said boom sections in relation to each other also being used for the said determination of the position of the bolt.

12. Arrangement for determining the position of a rock reinforcing bolt installation in a tunnel or a mine, with the bolt installation being arranged to be carried out by means of a drilling rig, with the said drilling rig comprising at least one boom (11) with a first end and a second end, with the said first end being arranged to be attached to a carrier (12) via at least

one articulated connection, and with the said boom being arranged to carry an installation tool, **characterized in that** the arrangement comprises:

- means arranged on the drilling rig (10) for determination of a position for the said carrier,
- means for determination of at least one angle for the said boom (11) in relation to the carrier by the determination of an angle of rotation for the said articulated connection, and
- means for the determination of the position of the rock reinforcing bolt in the tunnel or mine on the basis of the said position of the carrier (12) and the said determined angle of rotation.

13. Arrangement according to Claim 12, with the position of the rock reinforcing bolt being arranged to be determined on the basis of a length of the said boom (11).

14. Arrangement according to Claim 12 or 13, with the arrangement, in addition, comprising means for determining a direction for the said reinforcing bolt.

15. Arrangement according to any one of Claims 12-14, **characterized in that**, in addition, it comprises means for carrying out the said determination of a position of the said carrier (12) by determination of the directions to at least three reference points.

16. Arrangement according to Claim 15, with the said determination of directions being arranged to be carried out by means of at least one rotating laser or at least one directional antenna.

17. Arrangement according to any one of Claims 12-16, **characterized in that**, in addition, it comprises means for determining the inclination of the carrier in a lateral and/or longitudinal direction, during the said determination of the position of the bolt.

18. Arrangement according to any one of Claims 12-17, **characterized in that**, in addition, it comprises means for storing the said position of the bolt in a memory.

19. Arrangement according to any one of Claims 12-18, **characterized in that**, in addition, it comprises means for storing the positions of a plurality of reinforcing bolts in a memory.

20. Arrangement according to any one of Claims 12-19, **characterized in that**, in addition, it comprises means for converting stored data into a form that can be displayed visually.

21. Arrangement according to any one of Claims 12-20, **characterized in that**, in addition, it comprises means for transmitting the said determined position of the bolt to a remote location.

22. Arrangement according to any one of Claims 12-21, **characterized in that** it at least partially constitutes an integrated or associated part of the control system for a drilling rig.

23. Arrangement according to any one of Claims 12-22, **characterized in that** the said boom consists of at least two articulated boom sections, with at least one angle of the said boom sections in relation to each other also being arranged to be used for the said determination of the position of the bolt.

24. Drilling rig, **characterized in that** it comprises an arrangement according to any one of Claims 12-23.

Patentansprüche

1. Verfahren zur Bestimmung der Position zumindest eines Felsverstärkungsbolzens in einem Tunnel oder einer Mine, wobei die Bolzeninstallation dazu angeordnet ist, mittels einer Bohranlage (10) ausgeführt zu werden, wobei die Bohranlage (10) mindestens einen Ausleger (11) mit einem ersten Ende und einem zweiten Ende aufweist, wobei das erste Ende über zumindest eine Gelenkverbindung an einem Träger (12) befestigt ist, und wobei der Ausleger (11) dazu angeordnet ist, ein Installationswerkzeug (14) zu tragen,
dadurch gekennzeichnet, dass das Verfahren die folgenden Schritte aufweist:

- Bestimmen einer Position für den Träger (12) unter Verwendung von auf der Bohranlage (10) angeordneten Mitteln,
- Bestimmen zumindest eines Winkels für den Ausleger (11) in Bezug auf den Träger (12) durch Bestimmung eines Drehwinkels für die Gelenkverbindung,
- Bestimmen der Position des Felsverstärkungsbolzens im Tunnel oder der Mine basierend auf der Position des Trägers (12) und des bestimmten Drehwinkels.

2. Verfahren nach Anspruch 1, wobei die Position des Felsverstärkungsbolzens basierend auf einer Länge des Auslegers (11) bestimmt wird.

3. Verfahren nach Anspruch 1 oder 2, wobei das Verfahren zusätzlich den Schritt des Bestimmens einer Richtung für den Verstärkungsbolzen aufweist.

4. Verfahren nach einem der Ansprüche 1 - 3, **dadurch gekennzeichnet, dass** die Bestimmung einer Position für den Träger (12) eine Bestimmung der Rich-

tungen zu mindestens drei Referenzpunkten aufweist.

5. Verfahren nach Anspruch 4, bei dem die Bestimmung der Richtung mittels mindestens eines rotierenden Lasers oder mindestens einer Richtantenne durchgeführt wird.

6. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Bestimmung der Position des Bolzens zusätzlich die Bestimmung der Neigung des Trägers (12) in einer Seiten- und/oder Längsrichtung aufweist.

7. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es zusätzlich den Schritt des Speicherns der Position des Bolzens in einem Speicher aufweist.

8. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es zusätzlich den Schritt des Speicherns der Positionen von mehreren Verstärkungsbolzen in einem Speicher aufweist.

9. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es zusätzlich den Schritt des Umwandelns von gespeicherten Daten in eine visuell darstellbare Form aufweist.

10. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es zusätzlich den Schritt des Sendens der bestimmten Position des Bolzens an einen entfernten Ort aufweist.

11. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Ausleger (11) aus zumindest zwei gegliederten Auslegerabschnitten besteht, wobei zumindest ein Winkel der Auslegerabschnitte zueinander auch für die Bestimmung der Position des Bolzens verwendet wird.

12. Anordnung zur Bestimmung der Position mindestens eines Felsverstärkungsbolzens in einem Tunnel oder einer Mine, wobei die Bolzeninstallation dazu angeordnet ist, mittels einer Bohranlage ausgeführt zu werden, wobei die Bohranlage mindestens einen Ausleger (11) mit einem ersten Ende und einem zweiten Ende aufweist, wobei das erste Ende über zumindest eine Gelenkverbindung an einem Träger (12) befestigt ist, und wobei der Ausleger dazu angeordnet ist, ein Installationswerkzeug zu tragen,
dadurch gekennzeichnet, dass die Anordnung aufweist:

- Mittel, die auf der Bohranlage (10) angeordnet sind, zur Bestimmung einer Position für den Träger,
- Mittel zur Bestimmung von zumindest einem Winkel für den Ausleger (11) in Bezug auf den Träger durch die Bestimmung eines Drehwinkels für die Gelenkverbindung, und
- Mittel zur Bestimmung der Position des Felsverstärkungsbolzens im dem Tunnel oder der Mine basierend auf der Position des Trägers (12) und des bestimmten Drehwinkels.

13. Anordnung nach Anspruch 12, wobei die Position des Felsverstärkungsbolzens basierend auf einer Länge des Auslegers (11) bestimmt ist.

14. Anordnung nach Anspruch 12 oder 13, wobei die Anordnung zusätzlich Mittel zum Bestimmen einer Richtung für den Verstärkungsbolzen aufweist.

15. Anordnung nach einem der Ansprüche 12 - 14, **dadurch gekennzeichnet, dass** sie außerdem Mittel zur Durchführung der Bestimmung einer Position des Trägers (12) durch Bestimmung der Richtungen zu mindestens drei Referenzpunkten aufweist.

16. Anordnung nach Anspruch 15, wobei die Bestimmung von Richtungen dazu angeordnet ist, mittels mindestens eines rotierenden Lasers oder mindestens einer Richtantenne durchgeführt zu werden.

17. Anordnung nach einem der Ansprüche 12 - 16, **dadurch gekennzeichnet, dass** sie zusätzlich Mittel zur Bestimmung der Neigung des Trägers in einer Seiten- und/oder Längsrichtung, während der Bestimmung der Position des Bolzens, aufweist.

18. Anordnung nach einem der Ansprüche 12 - 17, **dadurch gekennzeichnet, dass** sie zusätzlich Mittel zum Speichern der Position des Bolzens in einem Speicher aufweist.

19. Anordnung nach einem der Ansprüche 12 - 18, **dadurch gekennzeichnet, dass** sie zusätzlich Mittel zum Speichern der Positionen mehrerer Verstärkungsbolzen in einem Speicher aufweist.

20. Anordnung nach einem der Ansprüche 12 - 19, **dadurch gekennzeichnet, dass** sie zusätzlich Mittel zum Umwandeln von gespeicherten Daten in eine visuell darstellbare Form aufweist.

21. Anordnung nach einem der Ansprüche 12 - 20, **dadurch gekennzeichnet, dass** sie zusätzlich Mittel zum Übertragen der bestimmten Position des Bolzens an einen entfernten Ort aufweist.

22. Anordnung nach einem der Ansprüche 12 - 21, **dadurch gekennzeichnet, dass** sie zumindest teilweise einen integrierten oder zugehörigen Teil des

Steuerungssystems für eine Bohranlage darstellt.

23. Anordnung nach einem der Ansprüche 12 - 22, **dadurch gekennzeichnet, dass** der Ausleger aus zumindest zwei gegliederten Auslegerabschnitten besteht, wobei mindestens ein Winkel der Auslegerabschnitte in Bezug zueinander auch dazu angeordnet ist, für die Bestimmung der Position des Bolzens verwendet zu werden.

24. Bohranlage, **dadurch gekennzeichnet, dass** sie eine Anordnung nach einem der Ansprüche 12 - 23 aufweist.

Revendications

1. Procédé pour déterminer la position d'au moins un boulon de consolidation de roche dans un tunnel ou une mine, l'installation de boulons étant conçue pour être réalisée au moyen d'un engin (10) de forage, ledit engin (10) de forage comportant au moins une flèche (11) dotée d'une première extrémité et d'une deuxième extrémité, ladite première extrémité étant fixée à un porteur (12) via au moins une liaison articulée, et ladite flèche (11) étant conçue pour porter un outil (14) d'installation, **caractérisé en ce que** le procédé comporte les étapes consistant à :

- déterminer une position dudit porteur (12) en utilisant des moyens disposés sur l'engin (10) de forage,
- déterminer au moins un angle de ladite flèche (11) par rapport au porteur (12) par détermination d'un angle de rotation pour ladite liaison articulée, et
- déterminer la position du boulon de consolidation de roche dans le tunnel ou la mine d'après ladite position du porteur (12) et ledit angle de rotation déterminé.

2. Procédé selon la revendication 1, la position du boulon de consolidation de roche étant déterminée d'après une longueur de ladite flèche (11).

3. Procédé selon la revendication 1 ou 2, le procédé comportant de plus l'étape consistant à déterminer une direction dudit boulon de consolidation.

4. Procédé selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** ladite détermination d'une position dudit porteur (12) comporte la détermination des directions vers au moins trois points de référence.

5. Procédé selon la revendication 4, ladite détermination de direction étant réalisée au moyen d'au moins un laser tournant ou d'au moins une antenne directionnelle.

6. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ladite détermination de la position du boulon comporte, de plus, la détermination de l'inclinaison du porteur (12) dans une direction latérale et/ou longitudinale.

7. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comporte de plus l'étape consistant à stocker ladite position du boulon dans une mémoire.

8. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comporte de plus l'étape consistant à stocker les positions d'une pluralité de boulons de consolidation dans une mémoire.

9. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comporte de plus l'étape consistant à convertir des données stockées en une forme qui peut être affichée visuellement.

10. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comporte de plus l'étape consistant à transmettre ladite position déterminée du boulon à un lieu distant.

11. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ladite flèche (11) est constituée d'au moins deux tronçons de flèche articulés, au moins un angle desdits tronçons de flèche l'un par rapport à l'autre étant également utilisé pour ladite détermination de la position du boulon.

12. Agencement pour déterminer la position d'un installation de boulons de consolidation de roche dans un tunnel ou une mine, l'installation de boulons étant conçue pour être réalisée au moyen d'un engin de forage, ledit engin de forage comportant au moins une flèche (11) dotée d'une première extrémité et d'une deuxième extrémité, ladite première extrémité étant conçue pour être fixée à un porteur (12) via au moins une liaison articulée, et ladite flèche étant conçue pour porter un outil d'installation, **caractérisé en ce que** l'agencement comporte :

- des moyens disposés sur l'engin (10) de forage pour la détermination d'une position dudit porteur,
- des moyens de détermination d'au moins un angle de ladite flèche (11) par rapport au porteur par la détermination d'un angle de rotation de ladite liaison articulée, et
- des moyens pour la détermination de la posi-

tion du boulon de consolidation de roche dans le tunnel ou la mine d'après ladite position du porteur (12) et ledit angle de rotation déterminé.

13. Agencement selon la revendication 12, la position du boulon de consolidation de roche étant prévue pour être déterminée d'après une longueur de ladite flèche (11).

14. Agencement selon la revendication 12 ou 13, l'agencement comportant de plus des moyens pour déterminer une direction dudit boulon de consolidation.

15. Agencement selon l'une quelconque des revendications 12 à 14, **caractérisé en ce qu'**il comporte de plus des moyens pour réaliser ladite détermination d'une position dudit porteur (12) par détermination des directions vers au moins trois points de référence.

16. Agencement selon la revendication 15, ladite détermination de directions étant prévue pour être réalisée au moyen d'au moins un laser tournant ou d'au moins une antenne directionnelle.

17. Agencement selon l'une quelconque des revendications 12 à 16, **caractérisé en ce qu'**il comporte de plus des moyens pour déterminer l'inclinaison du porteur dans une direction latérale et/ou longitudinale, pendant ladite détermination de la position du boulon.

18. Agencement selon l'une quelconque des revendications 12 à 17, **caractérisé en ce qu'**il comporte de plus des moyens pour stocker ladite position du boulon dans une mémoire.

19. Agencement selon l'une quelconque des revendications 12 à 18, **caractérisé en ce qu'**il comporte de plus des moyens pour stocker les positions d'une pluralité de boulons de consolidation dans une mémoire.

20. Agencement selon l'une quelconque des revendications 12 à 19, **caractérisé en ce qu'**il comporte de plus des moyens pour convertir des données stockées en une forme qui peut être affichée visuellement.

21. Agencement selon l'une quelconque des revendications 12 à 20, **caractérisé en ce qu'**il comporte de plus des moyens pour transmettre ladite position déterminée du boulon à un lieu distant.

22. Agencement selon l'une quelconque des revendications 12 à 21, **caractérisé en ce qu'**il constitue au moins partiellement une partie intégrée ou associée du système de commande pour un engin de forage.

23. Agencement selon l'une quelconque des revendications 12 à 22, **caractérisé en ce que** ladite flèche est constituée d'au moins deux tronçons de flèche articulés, au moins un angle desdits tronçons de flèche l'un par rapport à l'autre étant également prévu pour être utilisé pour ladite détermination de la position du boulon.

24. Engin de forage, **caractérisé en ce qu'**il comporte un agencement selon l'une quelconque des revendications 12 à 23.

Fig. 1

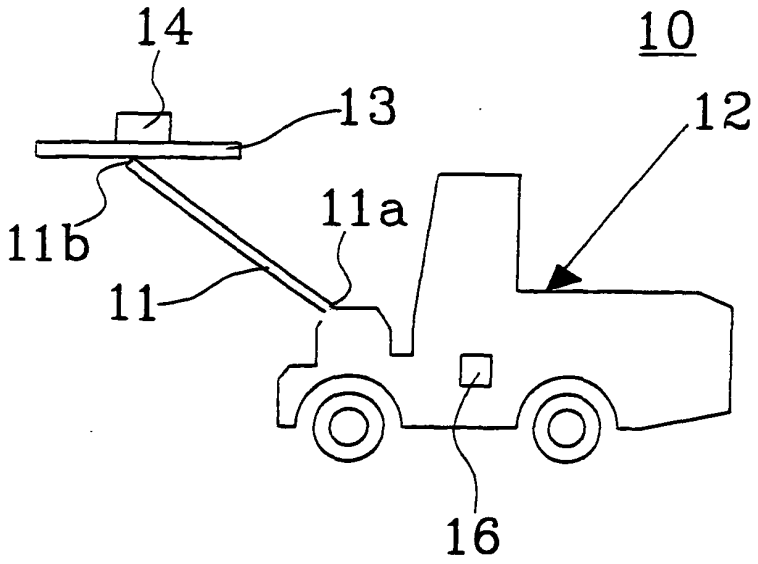
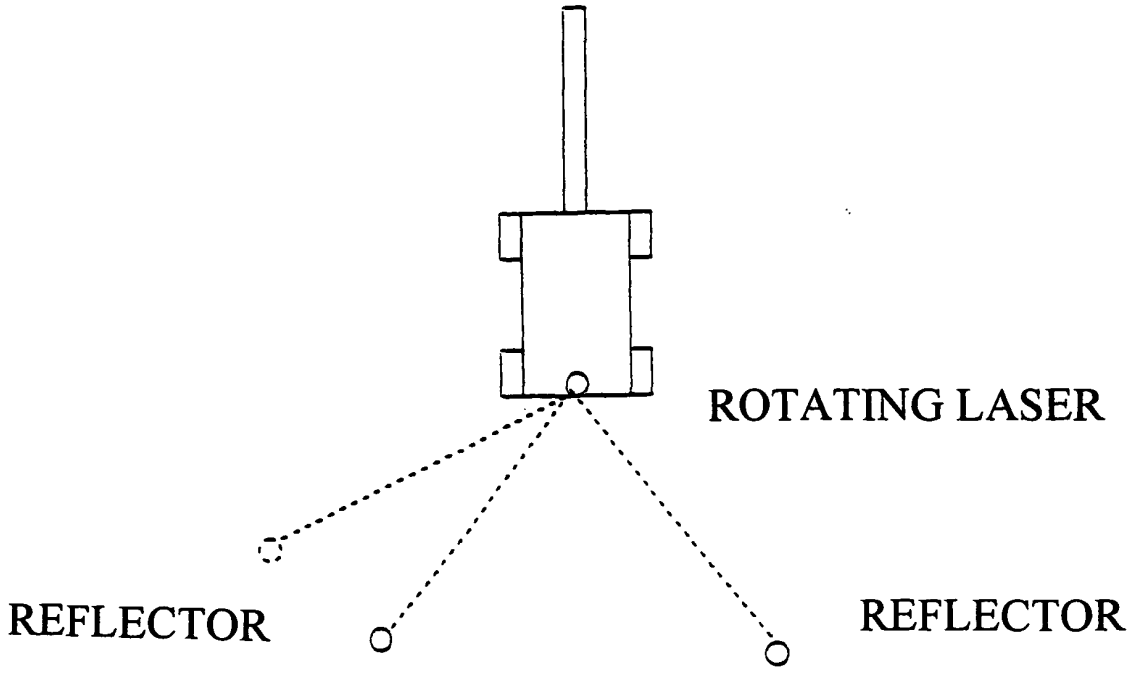


Fig. 2



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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