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(54) Title: A DRILL BIT PROVIDER, AN ARRANGEMENT AND A METHOD FOR PROVIDING AND REPLACING A DRILL BIT

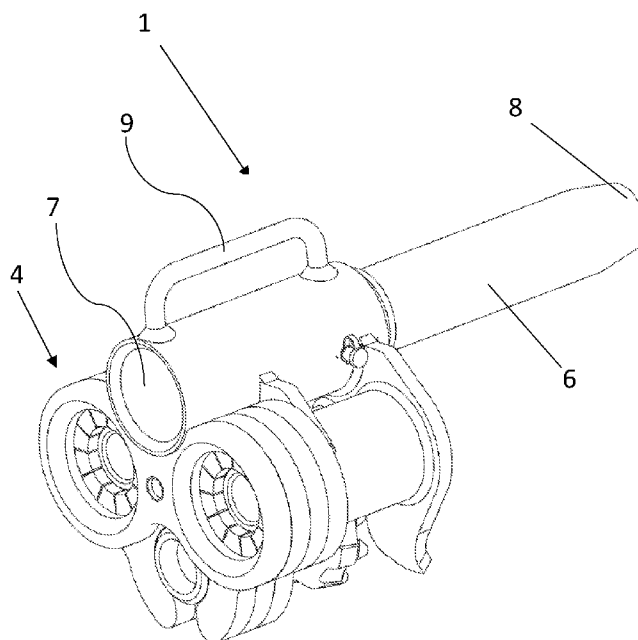


Fig. 1

(57) Abstract: Embodiments disclosed herein relate to a drill bit provider for use with a drill rig provided with one or more drill rods. The drill bit provider comprises a drill bit magazine for storing one or more replaceable drill bits used in rock drilling. Further, the drill bit carrier comprises a mounting arrangement provided with a first end arranged to fix said drill bit provider at a position in the vicinity to said drill rig, when disengaged from said one drill rod and fixed at the position.



A DRILL BIT PROVIDER, AN ARRANGEMENT AND A METHOD FOR PROVIDING AND REPLACING A DRILL BIT

TECHNICAL FIELD

5 The present disclosure relates in general to rock drilling, and to equipment which may be used in, for example, mining industry. More specifically, the disclosure relates to a drill bit provider for providing and replacing a drill bit adapted for rock drilling.

 Further, methods for providing and replacing a drill bit in a drill rod is provided.
10 The disclosure also relates to a rock drilling rig, as well as a computer program and a computer-readable medium that implement methods herein.

BACKGROUND

 In tunneling excavation or work in a mine, drill holes are drilled by a drill rig in
15 order to receive an explosive to be placed in each of the holes. The explosives are exploded in a blast and exploded rock is removed and new holes are drilled for a new round and a new blast.

 The number of boreholes in a single round may vary depending on the type of bedrock, and the type of task to be performed by the drill rig. At tunneling in a harder
20 type of rock, up to a large number of drill holes may need to be drilled for one single blast. Hard bedrock causes drill bits in the rock drill to wear quickly and there is a need of replacing the bits for regrinding. During such circumstances, a drill bit may only last enough to drill one to two holes before it needs to be discarded and replaced by a new drill bit. Further, the holes drilled for a blast may be of different
25 type or size, depending on the conditions on site. Therefore, a drill bit may need to be replaced by another, more suitable drill bit even if the drill bit is not yet worn out.

 Thus, when performing a rock drilling operation there is a recurrent need to replace the drill bits in use. Historically, the replacement of a worn drill bit has been performed manually by an operator. In case of manual change, the drilling machine
30 must be switched off which interferes with the operating process. Manual switching can also cause damage to the operator who performs the change.

Recently, other solutions have been presented to automate the change of a drill bit. Such solutions usually use a magazine and a complicated equipment to handle the magazine's movement when changing. A disadvantage of known solutions is that they often include many moving parts, which results in increased risk of downtime due to increased risk of breakdown of the parts in the very demanding and often dusty environment they are used in.

Thus, there is a need of a simplified and more safe replacement procedure that stand up to modern mining processing securing safe environment for the operators as well a smooth operation without unnecessary stops.

SUMMARY

A drill bit provider for use with a drill rig is provided with one or more drill rods. The drill bit provider comprises a drill bit magazine for storing one or more replaceable drill bits used in rock drilling, a mounting arrangement provided with a first end arranged to fix the drill bit provider at a position in the vicinity to the drill rig, when disengaged from the one drill rod. A second end is arranged to engage the drill bit provider to one of the drill rods during transportation of the drill bit provider. The drill bit provider can therefore be transported easily without the use of any additional means.

In embodiments, the mounting arrangement may be arranged to rotate. Thereby, the second end of the mounting arrangement can be engaged to the drill rod by rotating it. In embodiments, the second end may be provided with threads, and the provider may be engaged to the drill rod by a threaded connection. Thus, the second end can be screwed in place to engage to the drill rod.

In embodiments, the drill bit provider may at its first end be provided with a fixing drill bit, and fixing of the drill bit provider may be performed by drilling the first end of the mounting arrangement into a rock wall by use of the drill rod. Once transported to a desired position, this enables an easy and fast procedure for fixing the drill bit provider.

In embodiments, the drill bit provider may be arranged to be fixed on the ground. The drill bit provider may alternatively be arranged to be fixed in a present

drilling hole in the rock wall, and fixing of the drill bit provider may be performed by a split set providing a pressure towards the walls of the present drilling hole in order to fix the drill bit provider. Suitable holes may be present at an established working site, and an easy and fast procedure for fixing the drill bit provider is thereby provided.

5 In embodiments, the position and the angle of the fixed drill bit provider may be stored in the drilling plan related to the present task of the drill rig. Once a drill bit is to be replaced, this enables the rock drill to identify the position of the drill bit provider and to move to the stored position for executing a replacement of a drill bit. The drill bit provider may further comprise a gripper. The gripper may be used to
10 facilitate the replacement procedure. The one or more drill bit magazines may comprise two or more compartments, and the compartments may be arranged to hold drill bits of different size and type, and to provide a selected drill bit to any of the one or more drill rods. Thereby, the need of different types of drill bits are provided to the rock drill which may be advantageous if a more complex task is to be performed.

15 According to another aspect, a rock drilling arrangement comprising a rock drill and a drill bit provider according to embodiments herein is provided.

According to another aspect, a method for providing and replacing a drill bit used with a drill rod 3 is provided. A drill bit provider for use with a drill rig is provided with one or more drill rods. The drill bit provider comprises a drill bit magazine for
20 storing one or more replaceable drill bits used in rock drilling, and a mounting arrangement. The method comprises aligning one of the one or more drill rods with the drill bit provider, engaging the aligned drill rod with the drill bit provider by the mounting arrangement at a second end being arranged to attach to one of the drill rods, moving the drill bit provider, disengaging the provider from the drill rod and
25 fixing the drill bit provider before a drilling session is started.

Embodiments herein may further comprise selecting a drill bit from the positioned drill bit provider, and mounting the selected drill bit to the drilling rod. Embodiments herein may further comprise that engaging is performed by a threaded connection. Embodiments herein may further comprise that the mounting
30 arrangement at its first end is provided with a drill bit, and that fixing the drill bit provider comprises drilling it into a rock wall by use of the drill rod. Embodiments

herein may further comprise that the drill bit provider is arranged to be fixed on the ground.

In embodiments, methods herein may further comprise that the drill bit provider is placed in a rock drilling hole, and that fixing is performed by use of an expander to keep in hole. In embodiments methods herein may further comprise storing the position and angle of the positioned drill bit provider in the present drilling plan of the drill rig. In embodiments, where the drill rod comprises external threads and the drill bit comprises corresponding internal threads, methods herein may comprise engaging the drill bit to the drill rod by screwing tight the drill bit on the drill rod.

According to another aspect a computer program is provided. The computer program comprises instructions which, when the program is executed by a computer, cause the computer to carry out the methods disclosed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Aspects and details of embodiments herein, including particular features and advantages, will be readily understood from the following detailed description of one or several embodiments provided with reference to the accompanying drawings.

Figs. 1 and 2 are perspective views of a drill bit provider in accordance with embodiments described herein.

Fig. 3 is a cross sectional view of an exemplified embodiment disclosed herein.

Fig. 4 is a cross sectional view of another, alternative embodiments disclosed herein.

Fig. 5 is a perspective view of an arrangement comprising a drill rig and a drill bit provider in accordance with embodiments herein.

DETAILED DESCRIPTION

The present disclosure will now be described in more detail with reference to the accompanying drawings, in which exemplary embodiments are shown. However,

the disclosure is not to be considered as limited to the exemplified embodiments. Corresponding features and details have the same reference in the description below.

In Fig. 1 and 2 exemplary embodiments of a drill bit provider 1 are presented.

5 The drill bit provider 1 is intended for use with a drill rig 2 provided with one or more drill rods 3. The number of drill rods may vary depending on the type of drill rig, but is typically between one and four in drill rigs for mining. The drill bit provider 1 comprises a drill bit magazine 4 for storing one or more replaceable drill bits 5 used in rock drilling. As explained above, a drill bit in use with a drill rig needs to be
10 replaced due to wear, but may also be replaced by another drill bit of another type or size depending on the task performed by the drill rig.

The drill bit provider 1 further comprises a mounting arrangement 6. The mounting arrangement have a first end 7 arranged to engage the drill bit provider 1 to one of the drill rods 3 of the drill rig. Thereby, the drill bit provider can be engaged
15 with the drill rod during transportation of the drill bit provider 1. After the drill bit magazine 1 is engaged to the drill rod, the drill rig can be transported to the working site together with the drill bit provider. Thereby, a smooth transport of drill bits to the working site is provided. It is to be noted that if the drill rig is provided with several drilling rods, a drill bit provider may be engaged to each of the drill rods. Thereby,
20 more drill bits can be transported to the working site.

The second end 8 of the drill bit provider is arranged to fix the drill bit carrier 1 at a position in the vicinity to the drill rig 2. Thus, after transportation to the working site, the drill bit carrier is disengaged from the drill rod 3, or the respective drill rod, it is attached to, and placed at the chosen position after transportation. Fixing of the
25 drill bit carrier may be performed in several ways which will be described later.

In the examples shown in the Figs, the drill bit provider 1 comprises a drill bit magazine comprising two or more compartments. The compartments are arranged to hold drill bits of different size and type, and to provide a selected drill bit to any of the one or more drill rods. When in use, the drill bit provider works as follows. A drill
30 bit that for any reason is to be replaced, is positioned in an empty compartment in the drill bit provider. A soft collar of the inlet of the compartment of for example

rubber or the like, holds the drill bit with enough friction to enable the drill bit to be screwed off from the drill rod. Thereafter, the drill rod is backed and positioned in another compartment holding the new, desired drill bit. The soft collar holds the drill bit with frictional forces in a corresponding way and thereby enables the drill bit to be
5 screwed on to the drill rod. The drill rod can then be moved out from the compartment with the drill bit screwed onto it and is thus ready to use.

The mounting arrangement 6 may at its second end 8 be provided with a fixing drill bit 11, and fixing of the drill bit provider 1 may be performed by drilling the second end 8 of the mounting arrangement 6 into a rock wall by use of the drill rod 3.
10 Thanks to the fixing drill bit and by using the drill rod itself for actually drilling the provider 1 directly into the rock wall, a simple, fast and efficient fixing is performed without any need of external devices. Another advantage is that there is no need for any manual operations. The drill bit provider 1 may alternatively be arranged to be positioned on the ground and fixed by any suitable means, or hold in place by its
15 own weight. The drill bit carrier 1 may thus be mounted for example at a platform or directly at the bedrock.

In a further, alternative embodiment, the drill bit provider 1 may be arranged to be positioned in a present drilling hole in the rock wall. In that case, an expander like for example a split set may be used for fixing of the drill bit provider in the hole by
20 pressing the expander outwards towards the inner walls of the hole. The mounting arrangement may in such an embodiment be designed as a cylinder provided with one or more slits. If the second end is slightly sharpened, the cylinder can be pushed into the whole under a certain force, the slits will allow the cylinder to be compressed and a force acting on the inner walls of the hole will be provided. This is a simple and
25 robust solution of fixing the drill bit provider 1. At established working sites, often a number of unused drilling holes may be present.

Methods herein comprises providing and replacing a drill bit used with a drill rod 3. A drill bit provider 1 for use with a drill rig 2 is provided with one or more drill rods 3. The drill bit provider comprises a drill bit magazine 4 for storing one or more
30 replaceable drill bits 5 used in rock drilling, and a mounting arrangement 6. The method comprises aligning one of the one or more drill rods with the drill bit provider, engaging the aligned drill rod with the drill bit provider by the mounting arrangement

6 at a second end 8 being arranged to attach to one of the drill rod, moving the drill bit provider 1, disengaging the provider 1 from the drill rod 3 and fixing the drill bit provider 1 before a drilling session is started.

5 Methods herein may further comprise selecting a drill bit from the positioned drill bit provider 1, and mounting the selected drill bit to the drilling rod.

In methods herein, engaging may be performed by a threaded connection.

The mounting arrangement 6 may at its first end 7 be provided with a drill bit and fixing the drill bit provider 1 may comprise drilling it into a rock wall by use of the drill rod 3.

10 The drill bit provider 1 may be arranged to be fixed on the ground.

The drill bit provider may be placed in a rock drilling hole, and fixing may be performed by use of an expander to keep the provider in the hole.

Methods herein may further comprise storing the position and angle of the positioned drill bit provider in the present drilling plan of the drill rig.

15 The drill rod 3 may comprise external threads and the drill bit may comprise corresponding internal threads, and engaging the drill bit 1 to the drill rod 3 may comprise screwing tight the drill bit 1 on the drill rod 3.

CLAIMS

1. A drill bit provider (1) for use with a drill rig (2) provided with one or more drill rods (3), the drill bit provider (1) comprising:

- a drill bit magazine (4) for storing one or more replaceable drill bits (5) used in rock drilling;

- a mounting arrangement (6) provided with

second end (8) second end (8) and

a first end (7) arranged to fix said drill bit provider (1) at a position in the vicinity to said drill rig (2), when disengaged from said one drill rod (3) after transportation.

2. The drill bit provider (1) according to the preceding claim, wherein a second end (8) is arranged to engage the drill bit provider (1) to one of said drill rods (3) during transportation of the drill bit provider (1).

3. The drill bit provider (1) according any of the preceding claims, wherein said mounting arrangement (6) is arranged to rotate.

4. The drill bit provider (1) according to any of claims 2 or 3, wherein said second end (8) second end (8) is provided with threads, and wherein said provider (1) is engaged to the drill rod (3) by a threaded connection.

5. The drill bit provider (1) according to any of the preceding claims, wherein said mounting arrangement (6) at its first end (7) is provided with a fixing drill bit (11), and wherein fixing of the drill bit provider (1) is performed by drilling the first end (7) of the mounting arrangement (6) into a rock wall by use of said drill rod (3).

6. The drill bit provider (1) according to any of the preceding claims, wherein said drill bit provider (1) is arranged to be positioned on the ground.

7. The drill bit provider according to any of the preceding claims, wherein said drill bit provider (1) is arranged to be positioned in a present drilling hole in the rock wall, and wherein fixing of the drill bit provider (1) is performed by a split set providing a

pressure towards the walls of said present drilling hole in order to fix the drill bit provider (1).

8. The drill bit provider (1) according to any of the preceding claims, wherein the position and the angle of the fixed drill bit provider (1) is stored in the drilling plan related to the present task of the drill rig (2).

9. The drill bit provider (1) according to any of the preceding claims, further comprising a gripper.

10. The drill bit provider (1) according to any of the preceding claims, wherein said one or more drill bit magazines (4) comprises two or more compartments, and wherein said compartments are arranged to hold drill bits of different size and type, and to provide a selected drill bit to any of said one or more drill rods.

11. A rock drilling arrangement comprising a rock drill (2) and a drill bit provider (1) according to any of claims 1-10.

12. A mining machine comprising a drill bit provider (1) according to any of claims 1-10.

13. A method for providing and replacing a drill bit used with a drill rod (3), wherein a drill bit provider (1) for use with a drill rig (2) is provided with one or more drill rods (3), said drill bit provider comprises a drill bit magazine (4) for storing one or more replaceable drill bits (5) used in rock drilling, and a mounting arrangement (6), the method comprising:

- aligning one of said one or more drill rods (2) with said drill bit provider (1),
- engaging said aligned drill rod (3) with said drill bit provider (1) by said mounting arrangement (6) at a second end (8) being arranged to attach to one of said drill rod (3);
- moving the drill bit provider (1),
- disengaging the provider (1) from the drill rod (3),
- fixing the drill bit provider (1) before a drilling session is started.

14. Method according to the preceding claim, further comprising:

- selecting a drill bit from the positioned drill bit provider (1), and
- mounting said selected drill bit to said drilling rod.

15. Method according to any of claims 13 or 14, wherein

- 5 - engaging is performed by a threaded connection.

16. Method according to any of claims 13 - 15, said mounting arrangement (6) at its first end (7) being provided with a drill bit (11), wherein fixing the drill bit provider (1) comprises drilling it into a rock wall by use of the drill rod (3).

17. Method according to any of claims 13 - 16, wherein said drill bit provider (1) is
10 arranged to be fixed on the ground.

18. Method according to any of claims 13 - 17, wherein the drill bit provider is placed in a rock drilling hole, and fixing is performed by use of an expander to keep in hole.

19. Method according to any of claims 13 - 18, further comprising storing the position and angle of the positioned drill bit provider in the present drilling plan of the drill rig.

- 15 20. The method according to any of claims 13 - 19, wherein said drill rod (3) comprises external threads and said drill bit comprises corresponding internal threads, wherein engaging said drill bit (1) to said drill rod (3) comprises screw tight the drill bit (1) on the drill rod (3).

21. A computer program comprising instructions which, when the program is
20 executed by a computer, cause the computer to carry out the method according to any of claims 13 - 20.

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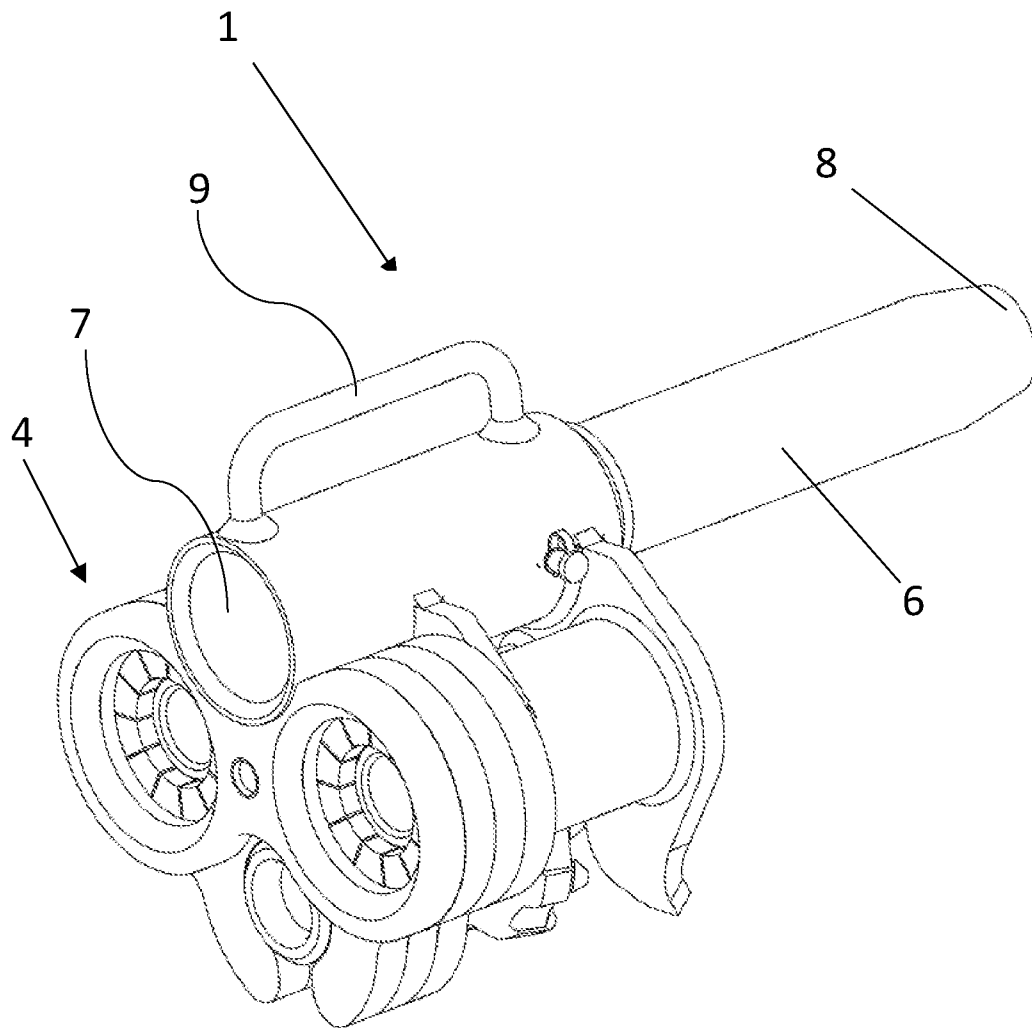


Fig. 1

2/5

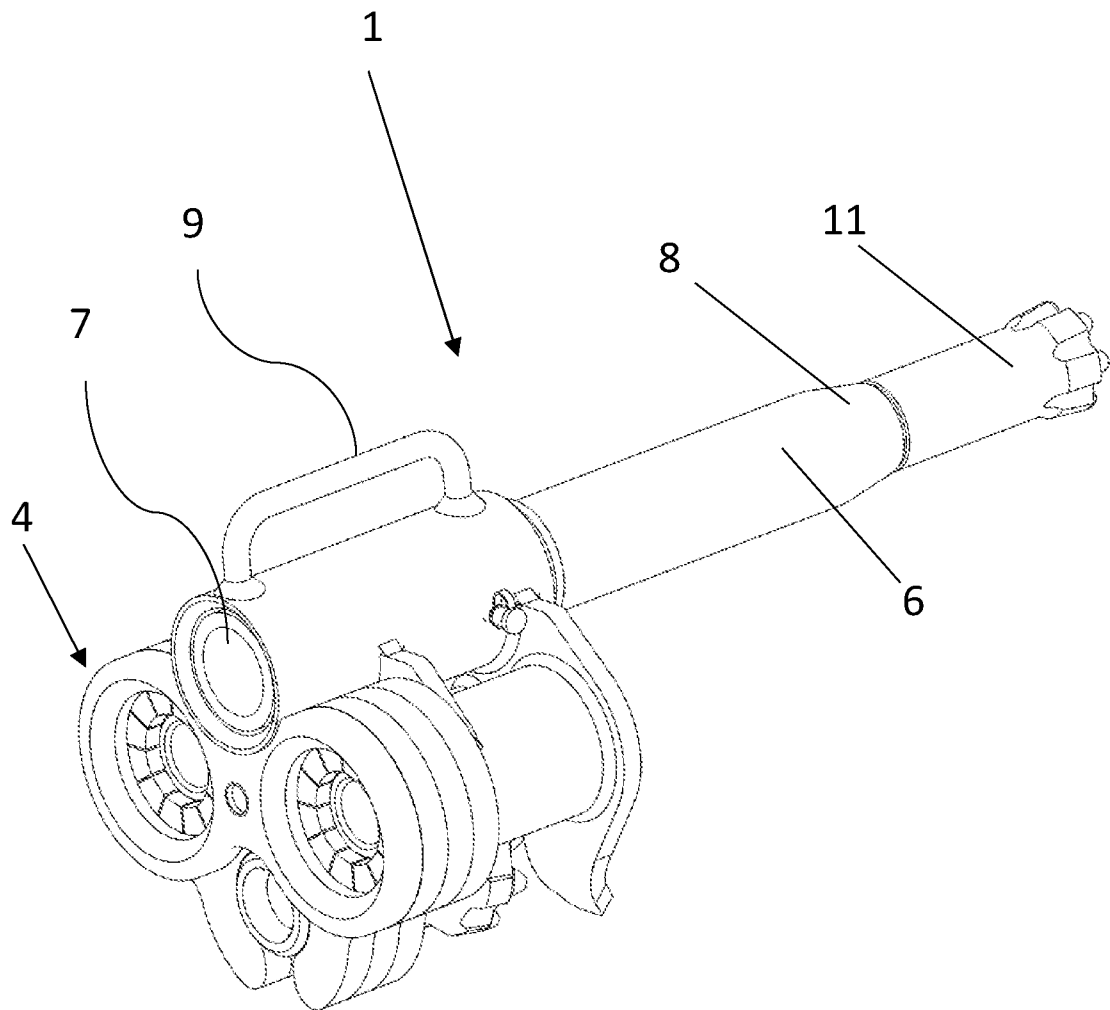


Fig. 2

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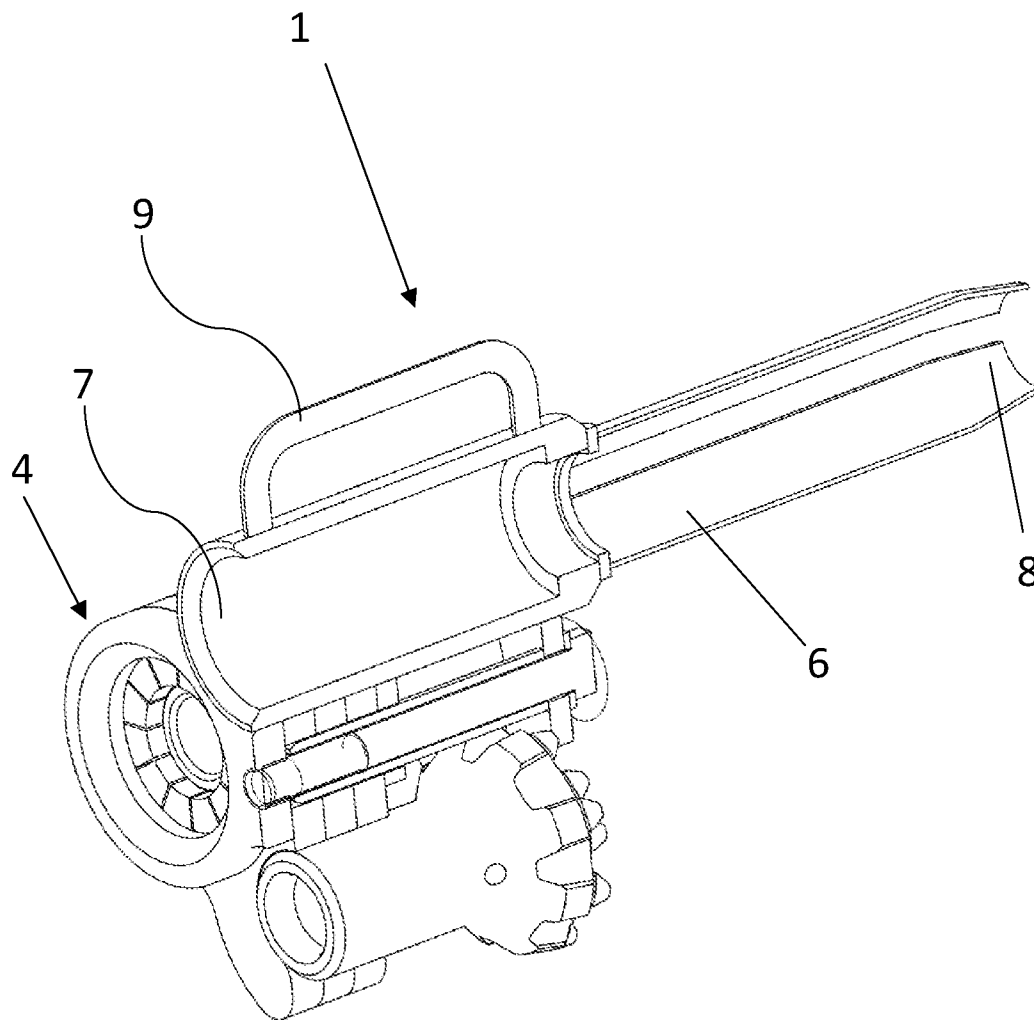


Fig. 4

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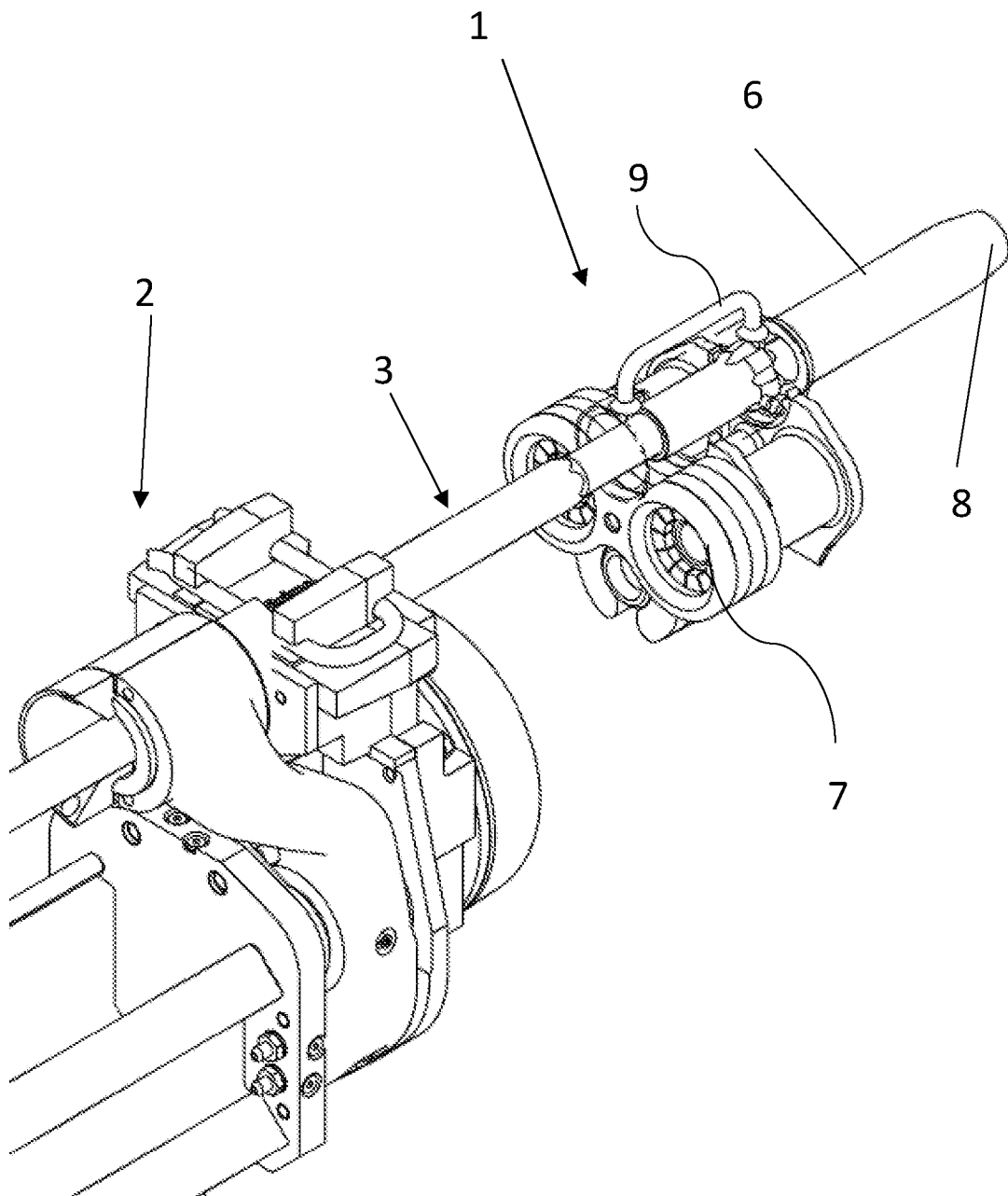


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2023/051305

A. CLASSIFICATION OF SUBJECT MATTER

INV. E21B12/00 E21B19/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2021/355767 A1 (AMERSON MICAH [US] ET AL) 18 November 2021 (2021-11-18) paragraphs [0025], [0026], [0029], [0032]; figures 2-6e -----	1 - 21
X	CN 116 357 240 A (CHINA RAILWAY CONSTR HEAVY IND CORP LTD) 30 June 2023 (2023-06-30) paragraphs [0050] - [0052], [0071]; figures 1-5 -----	1 - 21
X	WO 2008/054302 A1 (ATLAS COPCO ROCK DRILLS AB [SE]; ANDREN MATS [SE]; JONSSON HANS [SE]) 8 May 2008 (2008-05-08) paragraphs [0014] - [0020]; figures 2-3b -----	1 - 21



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

29 May 2024

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/SE2023/051305

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