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(71) Applicant: **Sandvik Canada Inc.**
Mississauga, Ontario L5N 8C2 (CA)

(72) Inventors:
- **CHOMOKOVSKI, Steve**
  Mississauga, Ontario (CA)
- **LETKEMAN, Jordan**
  Mississauga, Ontario (CA)

(74) Representative: **Lyytinen, Veera Elise et al**
Sandvik Mining and Construction Oy
Pihtisulunkatu 9
33330 Tampere (FI)

(54) LOADING DRILL RODS FROM CASSETTE TO DRILLING POSITION

(57) There is provided an apparatus, a cassette (106) for drill rods (104) and a rock drilling machine that comprise a loading arm (102) for loading drill rods (104) from a cassette (106) to a drilling position in a rock drilling machine. The loading arm (102) has two loading positions for receiving drill rods (104), said two positions comprising a first position for receiving drill rods (104) from the cassette (106), and a second position for receiving drill rods (104) from an external source.

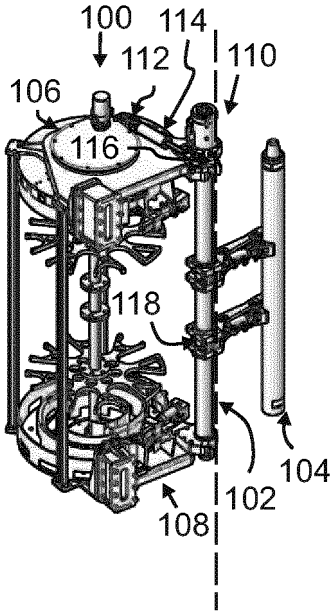

Figure 1d

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to loading drill rods from a cassette to a drilling position in a rock drilling machine

BACKGROUND OF THE INVENTION

[0002] In mines and other work sites rock drilling rigs are used for drilling bore holes on rock surfaces. Typically the rock drilling rig comprises one or more drilling booms which are provided with drilling units. In many cases drill holes having a greater length than one drill rod need to be drilled. Then two or more drill rods need to be connected to each other in order to form an extension rod. This is called extension rod drilling. Typically several drill rods are stored in a rod cassette which is arranged in the drilling unit. However, with many rods the rod cassette becomes large and heavy, whereby it may hamper the drilling. With not that many rods in the rod cassette, the size of the rod cassette can be smaller, but the re-loading the rod cassette can occur frequently which decreases the operational efficiency of the drilling unit.

BRIEF DESCRIPTION OF THE INVENTION

[0003] An object of the present invention is to provide an apparatus, a cassette for drill rods and a rock drilling machine so as to alleviate some of the above disadvantages. The objects of the invention are achieved by an apparatus, a cassette and a rock drilling machine which are characterized by what is stated in the independent claims. The preferred embodiments of the invention are disclosed in the dependent claims.

[0004] Some embodiments provide loading rods from a cassette and an external source by a single loading arm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] In the following the invention will be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which

Figures 1a to 1d illustrate an apparatus having a loading arm according to an embodiment;
and
Figure 2 illustrates a rock drilling machine according to an embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0006] Figures 1a to 1d illustrate an apparatus 100 having a loading arm 102 according to an embodiment. The apparatus is capable of loading drill rods 104 from a cassette 106 to a Drilling Position (DP) in a rock drilling machine by the loading arm. The loading arm may be a longitudinal structure extending parallel to the cassette and the rods in the cassette. The loading arm is capable of receiving at least one rod and attaching to the rod for moving the rod in and/or out of the cassette.

[0007] In the DP, rods may be connected to a tool for drilling a hole, i.e. a drill hole, by the rock drilling machine. The loading arm may be capable of movement that has a direction that is transverse to a longitudinal direction of the rods. Accordingly, the loading arm may move rods out of the cassette to the DP such that the longitudinal direction of the rods may be maintained for fast connection to the tool or other rods at the DP. The movement of the loading arm is described by Figures 1a to 1d that illustrate the loading arm in different positions. It should be appreacited that the loading arm may be turned from one position to another and vice versa such that rods may be moved between various positions by the loading arm.

[0008] Figure 1 c illustrates the loading arm in the drilling position. The loading arm has two loading positions for receiving drill rods. In each position at least one drill rod may be received to the loading arm. The rod received to the loading arm is attached to the loading arm, e.g. by a clamp, such that the rod may be moved between various positions by the loading arm. One of the positions is a position for receiving rods from the cassette. One of the positions is a position for receiving rods from an external source. This position is illustrated in Figure 1 a. In the position for receiving rods from the cassette, the rods may be received on at a time through a cassette gate 108. Accordingly, this position may be referred to as a Gate Position (GP). In the position for receiving rods from the external source, the rods may be received outside the cassette. This position is illustrated in Figure 1d. This position may be referred to as an Auxiliary (AUX) Position (P), AP. In both the AP and GP the rods may be received one by one. Since the loading arm has two positions for loading rods, the single loading arm is sufficient for loading rods to the drilling position. In case the cassette is empty for rods, the loading arm can be used to re-load the cassette from outside the cassette. In loading the cassette, rods may be fed to the cassette at the GP by moving rods from the AP to the GP.

[0009] In an embodiment a loading arm 102 may be arranged pivotably on the cassette 106, whereby the loading arm can be pivotally turned between the two loading positions, GP and AP, and the DP. Consequently a rod attached to the loading arm may be moved between the GP, AP and DP.

[0010] In an embodiment, a loading arm 102 may be arranged pivotably on the cassette 106 and the loading arm can be turned at least 90 degrees, preferably 100 to 180 degrees, even more preferably over 180 degrees, for example 270 degrees, between the two loading positions. The loading arm may be turned from one position to another and vice versa. This provides freedom to installing cassettes to rock drilling machines. The greater

the angle between the AP and the GP is, the more freedom is provided to the position of the GP and the position of the cassette with respect to the AP. Accordingly, the cassette may be installed into a rock drilling machine to a position, where the distance between the AP and the GP. In such a case a large angle between the AP and the GP may provide that the AP is easily reachable for feeding a rod to the loading arm at the AP.

[0011] In an embodiment a loading arm 102 may be arranged pivotably on the cassette 106 and the loading arm may be capable of being turned from the GP to the AP past the drilling position without stopping at the drilling position. Accordingly, the loading arm may be moved from the GP past the drilling position to the AP. Between the drilling position the loading arm may be turned past an intermediate position illustrated in Figure 1c, before the loading may arrive to the AP illustrated in Figure 1d.

[0012] In an embodiment at least one rotating device 110, 112 may be operatively connected to a loading arm 102. A lever arm 114 may be operatively connected to a mounting point 116 in the loading arm. In this way the loading arm may be rotated around its longitudinal axis illustrated by dashed lines in Figures 1a, 1b, 1c and 1d. The rotating device may be capable of exerting a force that may be transferred to a movement of the loading arm by turning.

[0013] In an embodiment, the loading arm 102 may be rotated by the lever arm. The rotating device 112 may be connected to the loading arm via the lever arm 114. In this way the lever arm may be driven by the rotating device such that the loading arm may be turned. This allows positioning the rotating device and the loading arm at a distance of at least the length of the lever arm from each other.

[0014] In an embodiment, the loading arm 102 may be rotated directly by the rotating device 110. In this way the loading arm may be rotated by the rotating device and the lever arm 114 may act as a support and/or guide means for the loading arm. Accordingly, rotation of the rotating device may be communicated to the loading arm directly from the rotating device. In one example of the connection between the rotating device and the loading arm, the rotating device may have an axis that may be connected to the axis of the loading arm such that rotation of the axis of the rotating device causes rotation of the loading arm. The axes may be connected by connecting the ends of the axes.

[0015] It should be appreciated that the loading arm 102 may be driven by more than one rotating device 110, 112. One of the rotating devices may be directly connected to the loading arm and another rotating device may be connected to the end of the lever arm 114 remote from the mounting point 116. In this way the loading arm may be driven by two rotating devices, one of which is connected to the loading arm vie the lever arm and one of which is connected directly to the loading arm.

[0016] The lever arm 114 and the rotating device 110 directly connected to the loading arm 102 may be capable of rotating the loading arm simultaneously or separately. When the loading arm is simultaneously rotated by the rotating device and the lever arm, both the lever arm and the rotating device communicate forces to the loading arm at the same time such that the loading arm is caused to rotate. When the loading arm is rotated by the rotating device and the lever arm separately, the lever arm and the rotating device exert forces to the loading arm at separate times such that the loading arm is caused to rotate. In this way the work of rotating loading arm can be shared to separate phases in the rotation of the loading device which allows controlling the rotation of the loading arm in each phase by only one of the lever arm and the rotating device.

[0017] In an embodiment a rotating device 110 operatively connected to the loading arm may be an electric device. The electric device may transform electricity into movement of the loading arm 102. The electric device may be directly connected to the loading arm for driving the loading arm such that the loading arm may be turned. In one example, the electric device may be an electric motor.

[0018] In an embodiment a rotating device 112 operatively connected to the loading arm 102 may be a hydraulic device. The hydraulic device may transform changes of hydraulic pressure into movement of the loading arm. The loading arm may comprise a hydraulic cylinder that may be driven by the hydraulic device. The hydraulic device may be connected to the loading arm by the lever arm for driving the loading arm such that the loading arm may be turned. In one example, the hydraulic device may be a hydraulic pump.

[0019] In an embodiment, a rotating device 110, 112 may be directly connected to the loading arm 102 for driving the loading arm and a lever arm may be operatively connected to a mounting point 116 in the loading arm for rotating the loading arm around its longitudinal axis. The loading arm may be caused to rotate less than 90 degrees or substantially 90 degrees from the GP to a drilling position by the lever arm. After the drilling position, the loading arm may be caused to rotate to the AP by the rotating device directly connected to the loading arm. In this way the movement of the loading arm may be driven in phases, where one of the lever arm and the rotating device directly connected to the loading arm may drive the loading arm at a time.

[0020] It should be appreciated that the movement of the loading arm in phases may be supported by the cassette comprising mechanical stopping means. The mechanical stopping means may set the lever arm to operate between the GP and the DP such that the lever arm cannot drive the loading arm beyond the DP. In this way the lever arm may be driven between the GP and the DP even without sensors for determining when the loading arm is the GP and DP. The stopping means may be provided by a mechanical structure that may prevent movement of the lever arm away from the GP and to a position beyond the DP. In an example the stopping means may

be a screw fixed to a position in the cassette for stopping the movement of the lever arm beyond the DP. In a further example a hydraulic cylinder in the lever arm may have an eye that prevents the hydraulic cylinder to operate the lever arm beyond the DP.

[0021] In an embodiment, a loading arm 102 may comprise gripping means 118 arranged to extend in a transverse direction to the longitudinal axis of the loading arm for receiving drill rods in the two loading positions, GP and AP. Examples of the gripping means comprise a clamp. The clamp may be designed and dimensioned to hold a single rod at a time.

[0022] Figure 2 illustrates a rock drilling machine 200 according to an embodiment. The rock drilling machine may comprise an apparatus 202 described in the above embodiments with reference to Figures 1 a to 1 d. The apparatus may be or constitute a part of a cassette for drill rods. The rock drilling machine may comprise a drilling unit 204 capable of drilling holes at a drilling position. A plurality of drilling rods may be interconnected and fed to a drill hole 206 from the cassette and from the external source.

[0023] In an example the rock drilling machine may comprise a percussion device for generating impact pulses on a tool, and a rotating device for rotating the tool. At a drilling site, one or more drill holes may be drilled with the rock drilling machine. The drill holes may be drilled in a vertical direction or any other direction.

[0024] It should be appreciated that the various embodiments described herein may be applied also to other drilling machines than rock drilling machines. Drilling machines according to the embodiments may be capable of drilling rock and also other materials. Accordingly, advantages of the embodiments described above may be obtained with various drilling machines and materials that include but are not limited to rock.

[0025] It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. An apparatus comprising a loading arm (102) for loading drill rods (104) from a cassette (106) to a drilling position in a rock drilling machine **characterized in that** the loading arm (102) has two loading positions for receiving drill rods (104), said two positions comprising a first position for receiving drill rods (104) from the cassette (106), and a second position for receiving drill rods (104) from an external source.

2. An apparatus according to claim 1, **characterized in that** the loading arm (102) is arranged pivotably on the cassette (106), whereby the loading arm (102) can be turned pivotally between the two loading positions and the drilling position.

3. An apparatus according to claim 2 or **characterized in that** the loading arm (102) is turned at least 90 degrees, preferably 100 to 180 degrees, even more preferably over 180 degrees, for example 270 degrees, between the two loading positions.

4. An apparatus according to claim 2 or 3, **characterized in that** the loading arm (102) is capable of turning from the first loading position to the second loading position past the drilling position without stopping at the drilling position.

5. An apparatus according to claim 1, 2, 3 or 4, **characterized in that** the apparatus comprises at least one rotating device (110, 112) operatively connected to the loading arm (102) and a lever arm (114) operatively connected to a mounting point (116) in the loading arm (102) for rotating the loading arm (102) around its longitudinal axis.

6. An apparatus according to claim 5, **characterized in that** the rotating device (110) is an electric device.

7. An apparatus according to claim 5, **characterized in that** the rotating device (112) is a hydraulic device.

8. An apparatus according to claim 5, **characterized in that** the loading arm (102) is rotated by the lever arm (114).

9. An apparatus according to claim 5, **characterized in that** the loading arm (102) is rotated directly by the rotating device (110).

10. An apparatus according to claim 5, **characterized in that** the loading arm (102) is caused to rotate less than 90 degrees or substantially 90 degrees from the first loading position to the drilling position by the lever arm (114) and after the drilling position the loading arm (102) is caused to be moved to the second loading position by the rotating device (110) directly connected to the loading arm (102) for driving the loading arm (102).

11. An apparatus according to any one of claims 1 to 10 **characterized in that** the loading arm (102) comprises gripping means arranged to extend in a transverse direction to the longitudinal axis of the loading arm (102) for gripping to drill rods (104) in the two loading positions.

12. A cassette (106) for drill rods (104), **characterized in that** the cassette (106) comprising an apparatus according to any one of claims 1 to 11.

13. A cassette (106) for drill rods (104) according to claim 12, **characterized in that** drill rods (104) are loaded from the external source to the cassette (106) and to the drilling position, and drill rods (104) are unloaded from the cassette (106) to the drilling position and/or to the external source.

14. A rock drilling machine **characterized in that** the rock drilling machine comprises a cassette (106) for drill rods (104) according to any one of claims 12 and 13.

15. A rock drilling machine according to claim 14, **characterized in that** the rock drilling machine comprises a drilling unit capable of drilling at the drilling position by interconnected drilling rods (104) fed to a drill hole from the cassette (106) and from the external source.

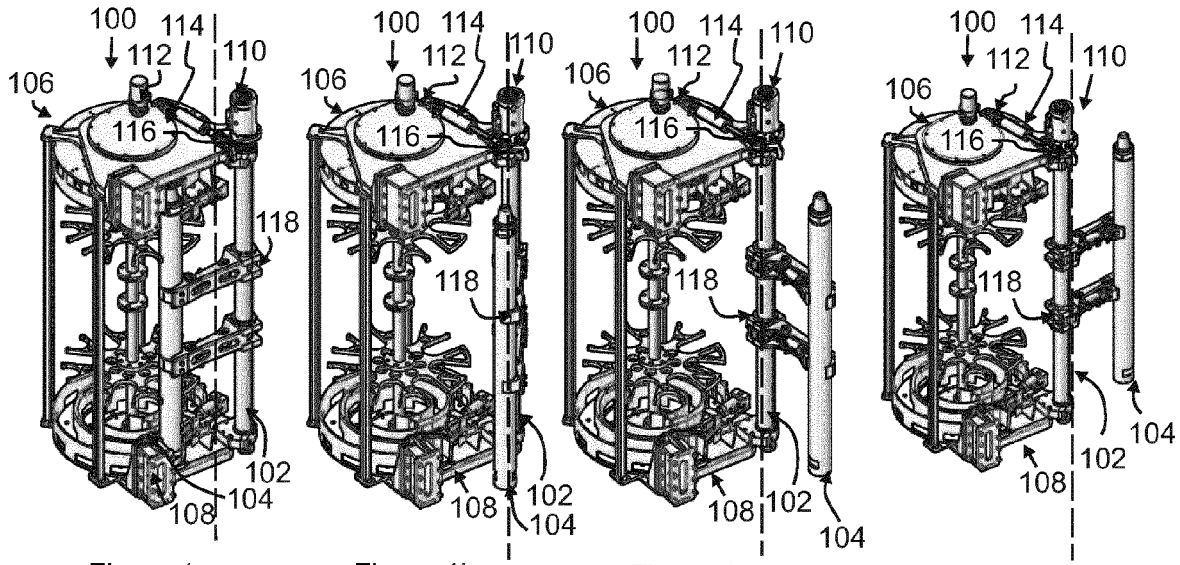

Figure 1a Figure 1b Figure 1c Figure 1d

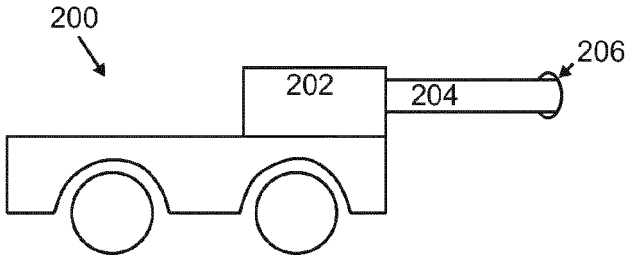

Figure 2

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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 6657

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 5 556 253 A (ROZENDAAL PETER C [US] ET AL) 17 September 1996 (1996-09-17) * column 3, line 65 - column 4, line 56 * * figures 1,4,5,8,10 *	1,5-15 2-4	INV. E21B7/02 E21B19/14
Y	US 2009/196712 A1 (MORTENSEN ASBJORN [SG] ET AL) 6 August 2009 (2009-08-06) * paragraph [0035] * * figures 1A-1C *	2-4	
A	EP 0 860 581 A1 (HUETTE BOHRTECH GMBH [DE]) 26 August 1998 (1998-08-26) * column 11, line 50 - column 12, line 12 * * figures 1-5 *	1-15	
A	US 2010/307827 A1 (PIIPPONEN JUHA [FI]) 9 December 2010 (2010-12-09) * paragraphs [0053], [0060] * * figures 5,6,11 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

E21B
E21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 March 2016	Schouten, Adri

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 18 6657

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04-03-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5556253 A	17-09-1996	NONE	
US 2009196712 A1	06-08-2009	SG 154422 A1	28-08-2009
		SG 173424 A1	29-08-2011
		SG 10201503315Q A	29-06-2015
		US 2009196712 A1	06-08-2009
		US 2012093614 A1	19-04-2012
EP 0860581 A1	26-08-1998	NONE	
US 2010307827 A1	09-12-2010	AU 2008339871 A1	02-07-2009
		CA 2707337 A1	02-07-2009
		CN 101903614 A	01-12-2010
		EP 2231999 A1	29-09-2010
		FI 20075953 A	22-06-2009
		JP 5361905 B2	04-12-2013
		JP 2011506803 A	03-03-2011
		US 2010307827 A1	09-12-2010
		WO 2009080876 A1	02-07-2009

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