Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 3069895 A1 2020/08/14

(21) 3 069 895

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2020/01/27

(41) Mise à la disp. pub./Open to Public Insp.: 2020/08/14

(30) Priorité/Priority: 2019/02/14 (EP19157067.0)

(51) Cl.Int./Int.Cl. *E21B 7/00* (2006.01),
E21B 7/02 (2006.01)

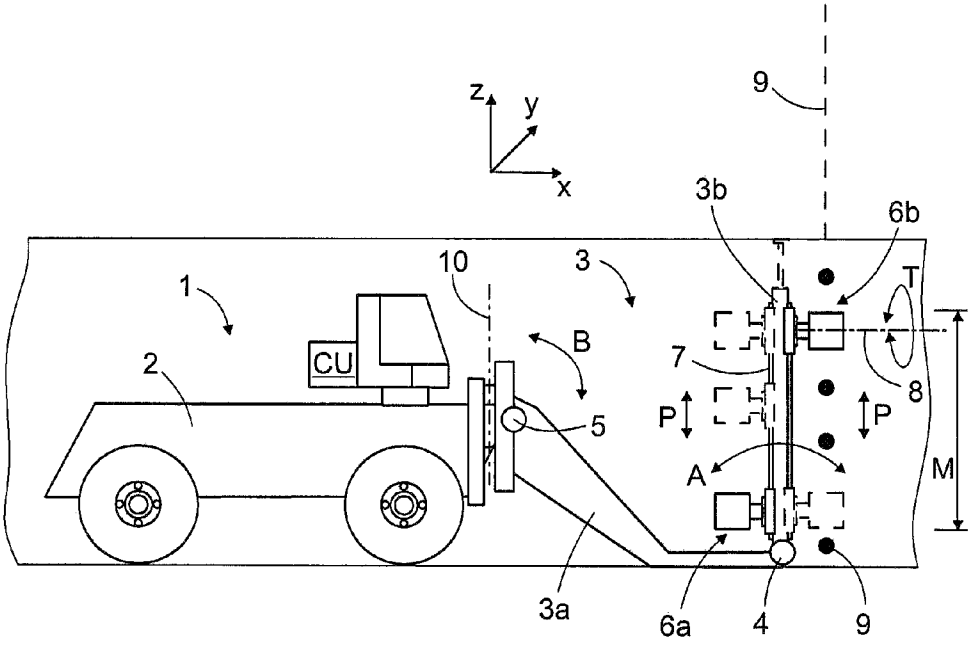
(71) Demandeur/Applicant:
SANDVIK MINING AND CONSTRUCTION OY, FI

(72) Inventeurs/Inventors:
KOSKINEN, KIMMO, FI;
YLI-HANNUKSELA, TERO, FI;
SIMILA, JUKKA, FI;
MAKINEN, TAPIO, FI;
HIETIKKO, TONI, FI

(74) Agent: GOWLING WLG (CANADA) LLP

(54) Titre : DISPOSITION DE LA PERFORATRICE DE ROCHES, INSTALLATION DE PERFORATRICE DE ROCHES ET METHODE DE PERCAGE

(54) Title: ROCK DRILLING ARRANGEMENT, ROCK DRILLING RIG AND DRILLING METHOD



(57) Abrégé/Abstract:
A rock drilling arrangement, rock drilling rig and drilling method. The rock drilling arrangement (14) comprises a drilling boom (3) which is mountable to a carrier (2) of the rock drilling rig (1). The boom is provided with two rock drilling units (6a, 6b) arranged movably (P) in longitudinal direction of the boom. Further, the drilling units may be moved independently relative to each other.

Abstract

A rock drilling arrangement, rock drilling rig and drilling method. The rock drilling arrangement (14) comprises a drilling boom (3) which is mountable to a carrier (2) of the rock drilling rig (1). The boom is provided with two rock drilling units (6a, 6b) arranged movably (P) in longitudinal direction of the boom. Further, the drilling units may be moved independently relative to each other.

(Figure 5)

Rock drilling arrangement, rock drilling rig and drilling method

Background of the invention

The invention relates to a rock drilling arrangement for drilling drill holes to rock surfaces.

The invention further relates to a rock drilling rig and method.

The field of the invention is defined more specifically in the preambles of the independent claims.

In mines, construction sites and at other work areas different type of rock drilling rigs are used. The rock drilling rigs are provided with one or more drilling booms and rock drilling units are arranged at distal ends of the booms for drilling drill holes. The purpose of drilling holes in rock may be forming blast holes for detaching rock material by blasting, or the drill holes may be drilled in order to reinforce the rock surface by mounting rock bolts or other reinforcements inside the drilled holes. Typically a great number of drill holes needs to be drilled in both cases. The present rock drilling arrangements have shown to contain some disadvantages especially regarding their productivity.

Brief description of the invention

An object of the invention is to provide a novel and improved rock drilling arrangement, rock drilling rig and method for rock drilling.

The rock drilling arrangement according to the invention is characterized by the characterizing features of a first independent apparatus claim.

The rock drilling rig according to the invention is characterized by the characterizing features of a second independent apparatus claim.

The method according to the invention is characterized by the charactering features and steps of an independent method claim.

An idea of the disclosed solution is that a rock drilling rig comprises a single drilling boom and the boom is provided with a freely movable tandem drilling unit system. Thereby, the drilling boom comprises two drilling units which can be positioned independently to desired positions relative to each other. The drilling units may be moved independently, which means that trajectories of the drilling unit are separate and do not cross. In other words, the drilling units are free to pass each other.

An advantage of the disclosed solution is that when two drilling units can be moved and positioned independently to desired positions, the operation of the device is flexible and increased productivity is achieved. The drilling units do not need to wait each other since they may pass each other, and further, their movement ranges are not limited by each other. Proper positions can be freely selected for the drilling units to execute the drilling of a planned drilling pattern. This way the rock drilling may be executed in a quick and efficient manner.

According to an embodiment, both rock drilling units comprise a feed beam and a rock drilling machine supported movably on the feed beam.

According to an embodiment, the disclosed solution is intended for reinforcing rock surface.

According to an embodiment, the disclosed solution is intended for drill and blast excavation method.

According to an embodiment, the drilling units are movable vertically during their operation. Thus, the drilling boom comprises at least one vertically directed part for supporting the drilling units and allowing their vertical movement.

According to an embodiment, the disclosed solution is intended for a so called fan-drilling, wherein several drill holes are drilled to the rock surface so that the drill holes form a kind of fan-shaped pattern comprising

drill holes directed laterally and drill holes directed upwards. The drill holes of the fan may be charged with explosives or they may receive reinforcing bolts.

According to an embodiment, both rock drilling units have moving range in longitudinal direction of the drilling boom. The rock drilling units are independently movable in the longitudinal direction of the drilling boom for the full moving range all the time. When the drilling units can be driven between their extreme positions without limitations, the solution has good reach. The length of the available moving range may be the same for both drilling units.

According to an embodiment, the drilling units are movable simultaneously and in any longitudinal direction on their own linear guide surfaces. Design of the drilling boom is firm enough, or the boom is additionally supported to the surrounding surfaces, so that both drilling units may be moved without causing stability problems. The two drilling units may also drill and perform their other work steps simultaneously at the same time without disturbing each other.

According to an embodiment, one or both of the mentioned two rock drilling units comprise feed means for feeding reinforcing components to a drill hole drilled by means of a rock drilling machine of the rock drilling unit. In other words, the drilling unit comprises means for making holes and for providing them with reinforcements.

According to an embodiment, the feed means mentioned in the previous paragraph above are configured to manipulate elongated rock bolts. The manipulation may comprise storing, handling, feeding and tightening measures.

According to an embodiment, the above mentioned reinforcing component to be fed inside the drilled hole is one of the following: rock bolt, self-drilling anchoring bolt, reinforcing cable, injection material. Thus, there are several alternative ways to reinforce rock surfaces.

According to an embodiment, the rock drilling units are mounted on carriages which are movable independently relative to the boom. Further, between the carriages and the drilling units are rotation units for turning the rock drilling units independently relative to the boom. The carriages are moved in longitudinal direction of the boom and rotation axis of the rotation units are perpendicular relative to the movement direction of the carriages.

According to an embodiment, the drilling boom comprises a first side facing towards a forward moving direction of a rock drilling rig and an opposite second side facing towards a rearward moving direction. The above mentioned first carriage is mounted on the first side and the second carriage is mounted on the opposing second side. Thus, the carriages are located on opposite sides of the drilling boom. This way the carriages are free to move on their own sides and they do not disturb each other.

According to an embodiment, the rotation unit, which is located between the carriage and the drilling unit, comprises at least a rotation motor. The rotation motor may be a hydraulic motor. Some cases the rotation motor may alternatively be an electric motor. Further, the rotation unit may comprise only the motor or it may be a combination of a rotation gear and the rotation motor.

According to an embodiment, the drilling boom has two-part configuration. The drilling boom comprises a first boom part connectable to a movable carrier of a rock drilling rig, and a distal second boom part. Between the boom parts is a joint whereby the second boom part can be turned relative to the first boom part. Further, the two rock drilling units are mounted on opposing side surfaces of the second boom part and are movable in longitudinal direction of the second boom part.

According to an embodiment, the drilling boom comprises the first boom part and the distal second boom part

as it is disclosed in the previous embodiment above. Further, the boom is designed to be orientated during the operation so that the second boom part is orientated transversally relative to the first boom part.

According to an embodiment, the first boom part is configured to be orientated horizontally, or substantially horizontally, during the operation of the rock drilling units. The second boom part is configured to be orientated vertically, or substantially vertically, during the operation. The horizontal first boom part may be supported against ground or bottom surface whereby the boom is stable.

According to an embodiment, the second boom part is tiltable forwards and backwards relative to the horizontal joint which is located between the boom parts. Then the second boom part and the drilling units may be easily orientated and drill holes may be drilled according a drilling plan.

According to an embodiment, in order to improve stability the mentioned horizontal first boom part may be supported against the ground during the drilling operation. Furthermore, the second boom part may have one or more extendable support element for supporting the boom to the rock surface. The support element may be a telescopic structure or a simply a hydraulic cylinder. The extendable support may be movable vertically, whereby it may be pushed against a ceiling of a tunnel or corresponding rock space.

According to an embodiment, the drilling boom has a transport position and an operational position. Then the first and second boom parts may be moved to the transport position wherein the first boom part is being lifted upwards at a distance from the ground level and the second boom part is tilted backwards towards the carrier of the rock drilling rig. The operational position has already disclosed above.

According to an embodiment, the drilling boom comprises a first boom part connectable to a carrier of a rock drilling rig, and a distal second boom part. The second boom

part comprises a frame and first and second elongated guide elements supported to the frame. A first carriage is supported linearly movably to the first guide element and a second carriage is supported linearly movably to the second guide element. The carriages are moved relative to the frame by means of dedicated actuators. Thanks to the mentioned dedicated guide elements, carriages and actuators the drilling units may be freely positioned to desired operational positions in the longitudinal direction of the vertically, or substantially vertically orientated second boom part. In other words, the drilling units may be driven to desired height positions in order to execute their work cycle with good performance.

According to an embodiment, the second boom part comprises two first guide elements and two second guide elements for supporting the carriages. The mentioned two first guide elements are located at a transverse distance from each other, and similarly, the two second guide elements are located at a transverse distance from each other. The disclosed structure provides stabile and accurate movement for the drilling units.

According to an embodiment, the above mentioned guide elements of the second boom part are round bars or tubes. Then the structure may be simple and round surfaces of the guide elements provide good slide surfaces.

According to an embodiment, the above mentioned first and second actuators for moving the carriages are hydraulic cylinders.

According to an embodiment, the second boom part comprises a frame having two longitudinal beams at a transverse distance from each other, and being connected to each other at their first and second ends by means of transverse frame parts. Thus, the frame has rectangle form framing a device space provided with the above mentioned guide elements and cylinders. The disclosed frame structure may be relative light in weight and still firm, and further, the

guide bars and cylinders are easy to mount between the transverse portions of the frame. The guide bars mounted between the transverse portions of the frame may provide additional support for the frame structure. Further, the rectangular frame configuration of the second boom part provides also shelter for the moving components mounted inside the device space between its framing bars and structures.

According to an embodiment, the second boom part comprises a frame having two transverse beams or frame parts at a distance from each other. The transverse frame parts are connected to each other by means of the guide bars mentioned above. Thus, in this solution the second boom part may be without separate longitudinal frame bars. An advantage is that weight of the second boom may be reduced and the structure is compact.

According to an embodiment, the solution relates to a rock drilling rig comprising a movable carrier, a drilling boom and two rock drilling units supported longitudinally movably on the drilling boom. The drilling boom and the rock drilling units are in accordance with the features disclosed in this document. Thereby the drilling boom is provided with a tandem drilling system wherein two drilling units are operable and movable independently relative to each other, whereby the two drilling units may operate freely relative to each other and effective drilling is achieved. One single boom is needed, and still, two drilling units are offered.

According to an embodiment, the solution relates to a method for drilling drill holes to a rock surface by means of a rock drilling arrangement comprising one drilling boom and two rock drilling units supported on the drilling boom. The method comprises moving the two drilling units in longitudinal direction of the drilling boom and executing the movements independently relative to each other. During the drilling the boom may be positioned so that at part of the drilling boom is vertically, or substantially vertically,

orientated and the drilling units move vertically when being positioned along the drilling boom.

According to an embodiment, selecting vertical positions for both drilling units freely from their dedicated full linear movement ranges at all times during the drilling operation. Thus, the entire movement potential is availably selectable for the positioning.

According to an embodiment, the method comprises moving one of the drilling units freely in the longitudinal direction of the drilling boom simultaneously when the other drilling unit executing its own work cycle, such as drilling.

The above disclosed embodiments may be combined in order to form suitable solutions having those of the above features that are needed.

Brief description of the figures

Some embodiments are described in more detail in the accompanying drawings, in which

Figure 1 is a schematic side view of a rock drilling rig provided with a drilling boom with tandem drilling units,

Figure 2 is a schematic diagram showing possible components of the disclosed arrangement;

Figure 3 is a schematic side view of an arrangement comprising a boom part provided with two longitudinally movable drilling units,

Figure 4 is a schematic top view of the solution disclosed in Figure 3, and

Figures 5 and 6 are schematic side views showing the solution of the previous Figures 3 and 4 at different position and orientation situations.

For the sake of clarity, the figures show some embodiments of the disclosed solution in a simplified manner. In the figures, like reference numerals identify like elements.

Detailed description of some embodiments

Figure 1 shows a rock drilling rig 1. The rock drilling rig 1 comprises a movable carrier 2 and one drilling boom 3. The boom 3 comprises a first boom part 3a connected to the carrier 2 and second boom part 3b connected to the first boom part 3a by means of a joint 4, whereby the second boom part 3b may be turned A to desired position. The first boom part 3a may be turned B relative to a joint 5. During the operation, the first boom part 3a may be horizontally orientated and may be supported on the ground or bottom surface. The second boom part 3b is vertically orientated and comprises two drilling units 6a, 6b. The second boom part 3b is provided with guide surfaces 7 along which the drilling units 6a, 6b may be moved P longitudinally on opposite sides of the second boom part 3b. The drilling units 6a, 6b have movement ranges M and both of them can be freely positioned to any desired position, as it is demonstrated in broken lines. The drilling units 6a, 6b may be turned T relative to transverse turning axis 8. The disclosed rock drilling rig 1 may be utilized for drilling drill holes 9 to rock surfaces locating above, laterally and in angular positions, and directions of the drilled holes 9 may vary.

Further, in some cases the entire boom system may be moved laterally relative to a turning axis 10 in order to facilitate positioning. The positioning and drilling process may be controlled automatically under control of a control unit CU or in a computer aided manner together with an operator. The control unit CU may be provided with a drilling or bolting plan and the drill holes 9 are drilled to planned positions and directions.

Figure 2 discloses that both drilling units 6a, 6b may comprises a feed beam 11 and a rock drilling machine 12 supported on it. The rock drilling machine 12 may comprise an impact device for generating impact pulses to a drilling tool, and a rotating device for rotating the tool around

its longitudinal axis. The rock drilling machine 12 may further comprises a flushing device for flushing drilling cuttings away from the drilled hole. When the drilling units 6a, 6b are intended for reinforcing the rock surface, then they may be provided with feed means 13 for feeding reinforcements to the drilled drill holes. The feed means 13 may comprises a feed storage, such as a rock bolt magazine, and feed manipulator.

Figure 3 discloses a rock drilling arrangement 14 comprising two rock drilling units 6a, 6b mounted on carriages 15a, 15b, which are movable P independently relative to a second boom part 3b. A first carriage 15a is supported on two first guide bars 16a, 16b and a second carriage 15b is supported on two second guide bars 17a, 17b. The carriages 15a, 15b may be provided with slide bearing elements 18 or other bearing arrangements. The guide bars 16a, 16b may be round bars or tubes arranged between two transverse frame parts 19. Thus, in the shown embodiment a frame 20 of the second boom part 3b comprises only the guide bars 16, 17 in the longitudinal direction. However, in some cases there may be separate longitudinal beams between outer ends of the transverse beams and these bars are not serving as guide bars. The guide bars 16, 17 serve as the elongated guide elements 7 mentioned above in connection with Figure 1. A first actuator 22a moves the first carriage 15a and a second actuator 22b moves the second carriage 15b. The actuators 22 may be hydraulic cylinders. Further, between the carriages 15 and the rock drilling units 6 are rotation units 23 for turning T the drilling units 6 to different angular positions. The drilling units 6 comprise feed beams 11 and rock drilling machines 12 with drilling tools 24. Figure 4 is a top view of the same apparatus 14.

Figures 5 and 6 disclose the apparatus 14 of Figures 3 and 4 in different operational positions. In Figure 5 the second drilling unit 6b is driven to its lower position and the first drilling unit 6a is at its upper position. In

Figure 6 the situation is vice versa. It is also possible that both drilling units 6 are at their upper or lower position, or at any vertical position within the movement range. Figures 5 and 6 also show that the drilling units 6 may be orientated in a desired manner.

The drawings and the related description are only intended to illustrate the idea of the invention. In its details, the invention may vary within the scope of the claims.

Claims

1. A rock drilling arrangement (14), comprising:

a drilling boom (3); and

two rock drilling units (6a, 6b) supported movably on the boom (3);

characterized in that

the rock drilling units (6a, 6b) are mounted on carriages (15a, 15b) which are movable (P) independently relative to the boom (3);

between the carriages (15a, 15b) and the rock drilling units (6a, 6b) are rotation units (23) for turning the rock drilling units (6a, 6b) independently relative to the boom (3);

and wherein the carriages (15a, 15b) are configured to be moved in longitudinal direction of the boom (3) and rotation axis (8) of the rotation units (23) are perpendicular relative to the movement direction of the carriages (15a, 15b).

2. The rock drilling arrangement as claimed in claim 1, characterized in that

both rock drilling units (6a, 6b) have moving range (M) in longitudinal direction of the drilling boom (3); and

the rock drilling units (6a, 6b) are independently movable (P) in the longitudinal direction of the drilling boom (3) for the full moving range (M) all the time.

3. The rock drilling arrangement as claimed in claim 1 or 2, characterized in that

at least one of the mentioned two rock drilling units (6a, 6b) comprises feed means (13) for feeding reinforcing components to a drill hole (9) drilled by means of a rock drilling machine (12) of the rock drilling unit (6a, 6b).

4. The rock drilling arrangement as claimed in any one of the preceding claims 1 - 3, characterized in that

the boom (3) comprises a first boom part (3a) connectable to a movable carrier (2) of a rock drilling rig (1), and a distal second boom part (3b);

between the boom parts (3a, 3b) is a joint (4) allowing the distal second boom part (3b) to be turned (A) relative to the first boom part (3a);

and wherein the rock drilling units (6a, 6b) are mounted on opposing side surfaces of the second boom part (3b) and are movable (P) in longitudinal direction of the second boom part (3b).

5. The rock drilling arrangement as claimed in any one of the preceding claims 1 - 4, characterized in that

the boom comprises a first boom part connectable to a carrier of a rock drilling rig, and a distal second boom part;

and wherein the boom (3) is configured to be orientated during the operation so that the second boom part (3b) is orientated transversally relative to the first boom part (3a).

6. The rock drilling arrangement as claimed in any one of the preceding claims 1 - 5, characterized in that

the boom (3) comprises a first boom part (3a) connectable to a carrier (2) of a rock drilling rig (1), and a distal second boom part (3b);

and wherein the second boom part (3b) comprises:

a frame;

at least one first elongated guide element supported to the frame;

at least one second elongated guide element supported to the frame;

a first carriage (15a) supported linearly movably (P) to the first guide element;

a second carriage (15b) supported linearly movably (P) to the second guide element;

at least one first actuator for moving (P) the first carriage (15a) relative to the frame; and

at least one second actuator for moving (P) the second carriage (15b) relative to the frame.

7. A rock drilling rig (1) comprising:

a movable carrier (2);

a drilling boom (3); and

two rock drilling units (6a, 6b) supported on the drilling boom (3);

characterized in that

the drilling boom (3) and the rock drilling units (6a, 6b) are according to the previous claims 1 - 6.

8. A method of drilling drill holes (9) to a rock surface by means of a rock drilling arrangement (14) comprising a drilling boom (3) and two rock drilling units (6a, 6b) supported on the drilling boom (3), and wherein the drilling units (6a, 6b) are moved relative to the drilling boom (3);

wherein the method comprises:

positioning at least part of the drilling boom (3) vertically;

moving (P) the drilling units (6a, 6b) vertically relative to the drilling boom (3) for positioning them to desired vertical positions;

characterized by

moving (P) the mentioned two rock drilling units (6a, 6b) in longitudinal direction of the drilling boom (3); and

executing the moving (P) of the two rock drilling units (6a, 6b) independently relative to each other.

9. The method as claimed in claim 8, characterized by

allowing the drilling units (6a, 6b) to execute their movements (P) for their full linear movement range (M) at all times during the drilling.

10. The method as claimed in claim 8 or 9, characterized by

allowing one of the drilling units (6a, 6b) to move (P) freely in the longitudinal direction of the drilling boom (3) simultaneously during the other drilling unit (6a, 6b) executing its drilling work cycle.

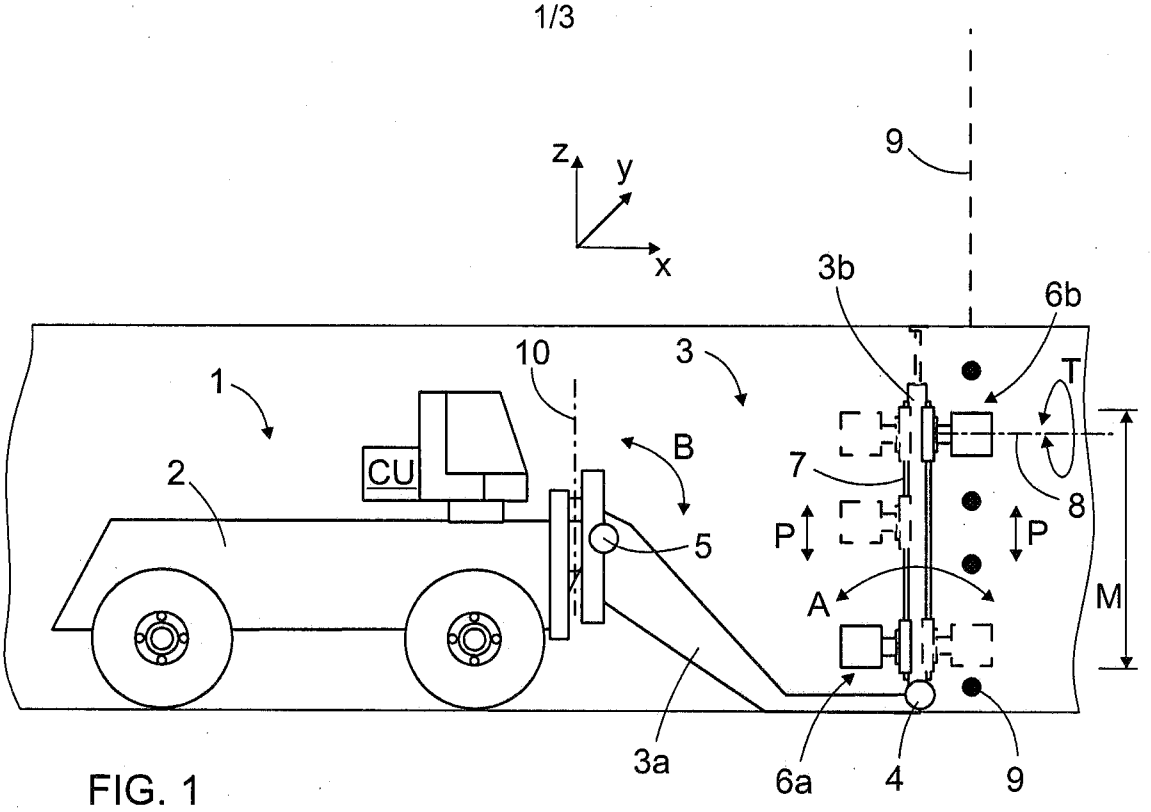

z
y
x
9
3b
6b
10
3
1
T
CU
B
2
7
8
P
P
5
A
M
3a
6a
4
9

FIG. 1

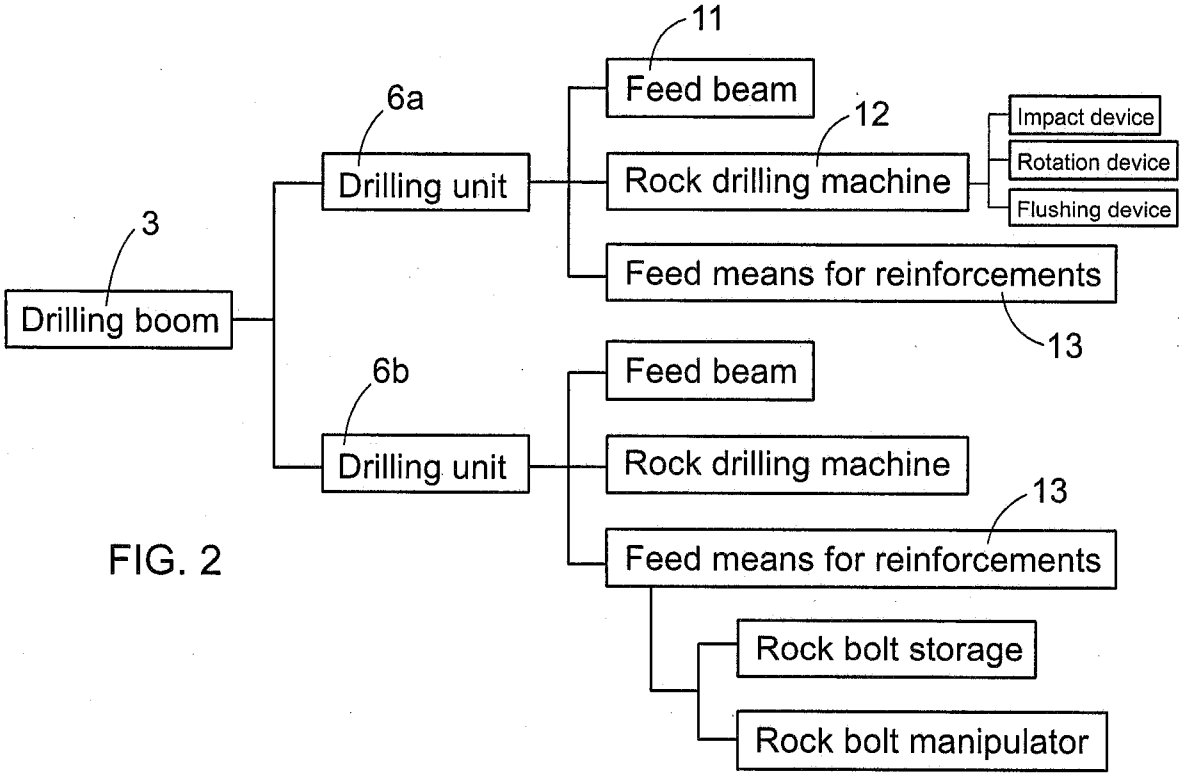

11
Feed beam
6a
12
Impact device
Drilling unit
Rock drilling machine
Rotation device
3
Flushing device
Drilling boom
Feed means for reinforcements
13
6b
Feed beam
Drilling unit
Rock drilling machine
13
Feed means for reinforcements
Rock bolt storage
Rock bolt manipulator

FIG. 2

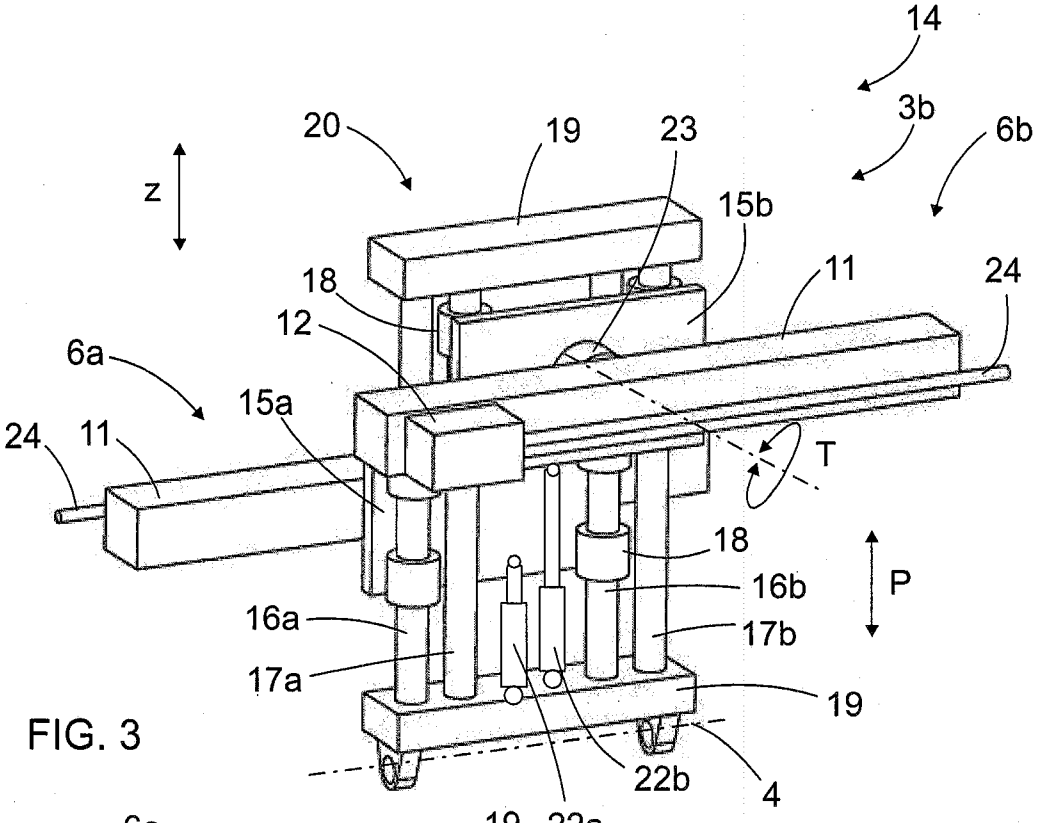

14
3b
6b
20
19
23
z
15b
11
24
18
12
6a
15a
24
11
T
18
16b
P
16a
17b
17a
19
22b
4

FIG. 3

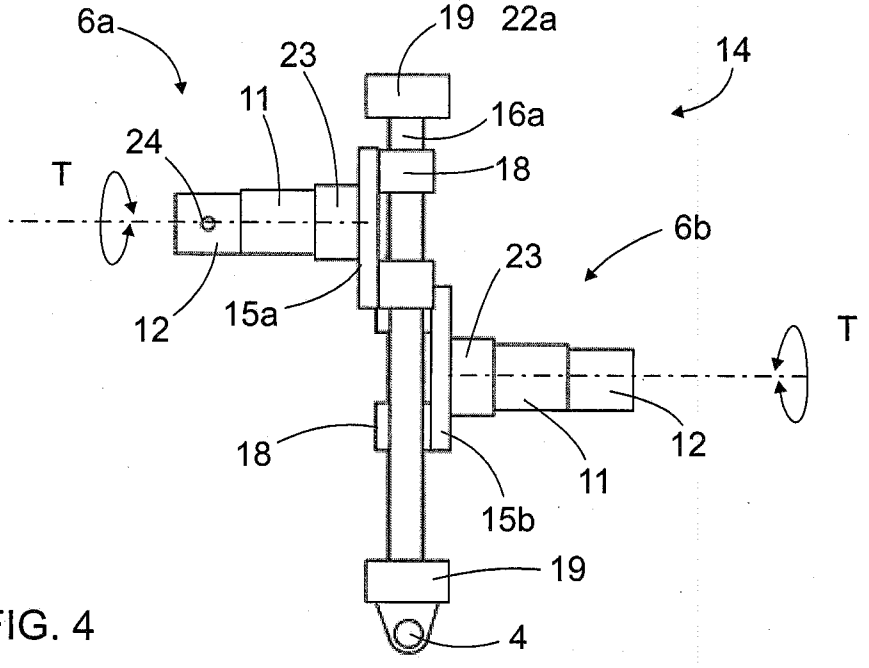

6a
19
22a
14
23
11
16a
24
18
T
6b
23
12
15a
T
18
12
11
15b
19
4

FIG. 4

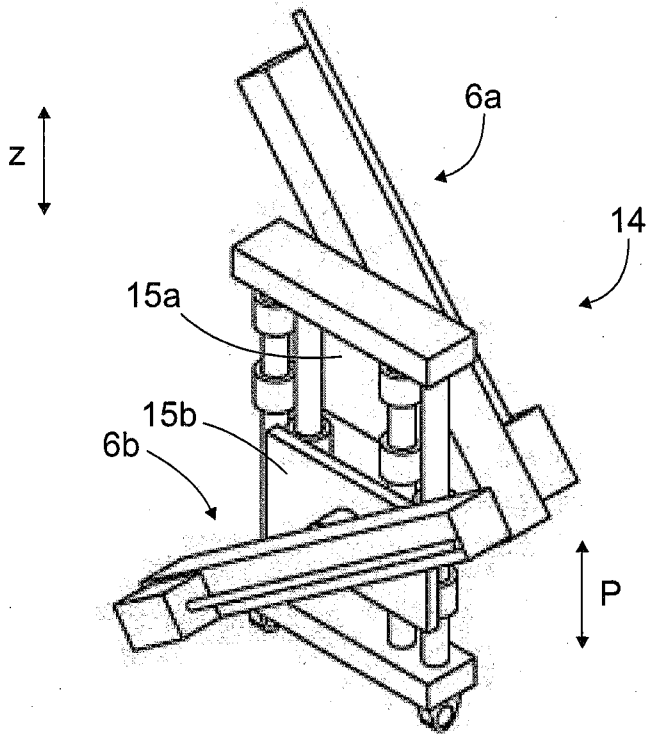


FIG. 5

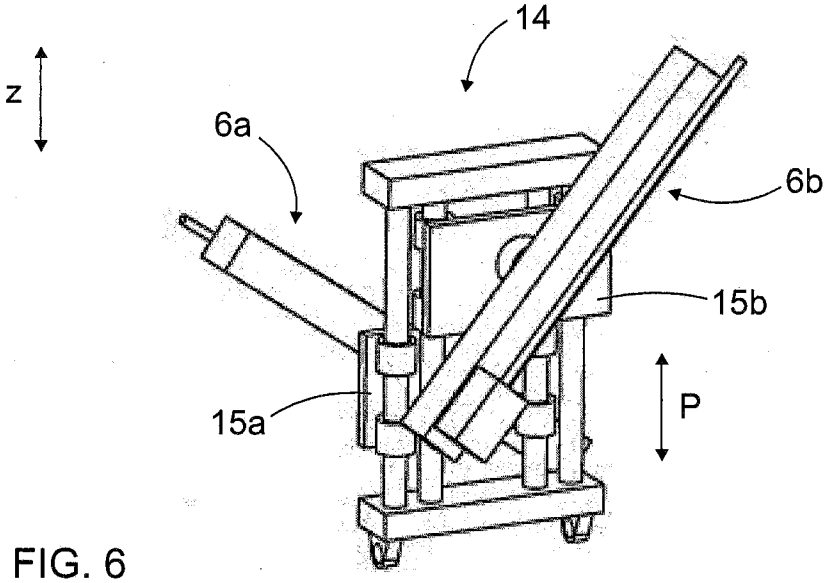
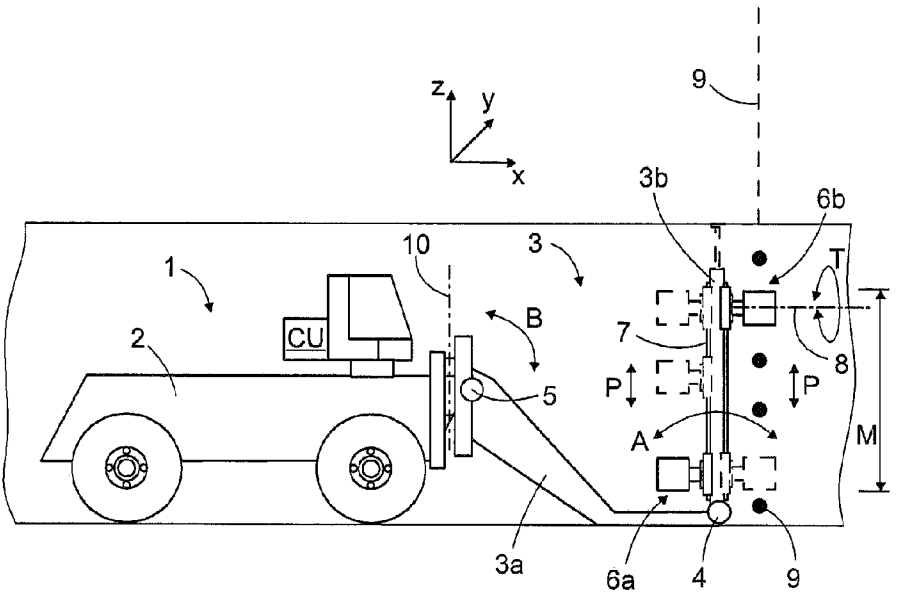


FIG. 6


z
y
x
9
3b
6b
10
3
1
T
B
CU
2
7
8
P
P
5
A
M
3a
6a
4
9