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(54) Title: BOOM ARRANGEMENT FOR ROCK DRILLING RIG

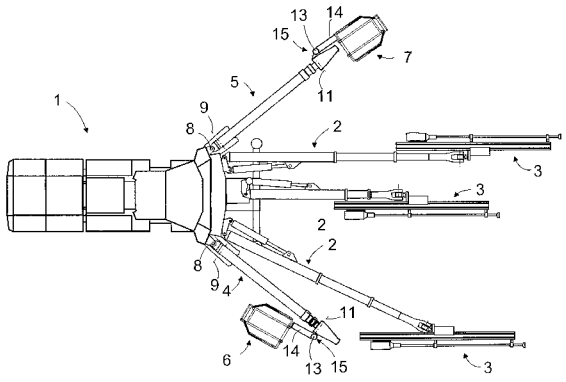

FIG. 2

(57) Abstract: The invention relates to an arrangement for mounting a cage to a lifting boom of a rock drilling rig comprising a carrier (1) to which the lifting boom (4; 5) is connected horizontally and vertically turnably, as well as actuators for turning the lifting boom (4; 5), whereby one end of the lifting boom (4; 5) is provided with a cage (6; 7) mounted with respect to the lifting boom (4; 5) turnably around a horizontal joint (11), as well as an actuator for turning the cage (6; 7) so that the cage (6; 7) remains in a substantially horizontal position irrespective of a vertical angle of the lifting boom (4; 5), as well as a vertical axle (13) and a turning device (15) for turning the cage in a transverse direction of the lifting boom (4; 5). In the arrangement, the cage (6; 7) is connected to the vertical axle (13) such that it is turnable to a side of the lifting boom (4; 5) from the vertical axle (13) towards the carrier (1) of the rock drilling rig.

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Boom arrangement for rock drilling rig

[0001] The invention relates to a rock drilling rig comprising a carrier whose front part is provided with one or more operating booms whose one end is provided with an actuator, and at least one lifting boom connected by joints to the front part of the carrier vertically and horizontally turnably, as well as first actuators for turning the lifting boom, and wherein one end of the lifting boom is provided with a cage mounted vertically with respect to the lifting boom and turnably around a horizontal joint, as well as a second actuator for turning the cage in relation to vertical turning of the lifting boom so that the cage remains in a substantially horizontal position irrespective of a vertical angle of the lifting boom, as well as a vertical axle and a turning device for turning the cage in a transverse direction of the lifting boom.

[0002] Rock drilling rigs are provided with personnel hoists movable in different ways and comprising a lifting boom and a cage arranged in its free end for hoisting people. Such devices are commonly used in tunnel making and in a technique called minibench excavation in particular. From the cage, it is possible to carry out rock bolting, measurements and inspections or other procedures requiring a close distance from the target. Further, it is convenient from the cage to carry out e.g. service and maintenance work during use of the rock drilling rig. Typically, the rock drilling rig in its front part further com¬ prises at least one operating boom whose free end is provided with a rock drill including its auxiliary devices or other devices necessary at a given time.

[0003] Typically, a boom is connected to the carrier of the rock drill¬ ing rig in a vertically and horizontally turnable manner so that it may be turned in a direction and to a height desired for the sake of the task. Typically, exist¬ ing lifting booms are devices called telescopic booms which in their longitudi¬ nal direction may be extended and contracted by an actuator as necessary. Similarly, in order to turn the lifting boom with respect to the carrier of the rock drilling rig, the boom is provided with actuators, typically hydraulic cylinders or the like.

[0004] Typically, the cage is connected to one end of the lifting boom around a horizontal axle, i.e. vertically turnably. Further, actuators are provided between the cage and the lifting boom to enable the cage to be turned, and the actuators of the lifting boom and the cage are connected to

cooperate such that when the lifting boom is turned up or down in the vertical direction, the cage turns with respect to the lifting boom correspondingly so that it always remains in a horizontal position.

[0005] A problem with such known solutions is that equipment and tools are difficult to place into the cage since even when lowered to its lowest position, the cage is still in front of the rock drilling rig and its own lifting boom. Similarly, under these conditions it is difficult and sometimes even dangerous to enter the cage. Such known lifting boom and cage solutions for personnel hoists are known from WO 01/8705 and WO 01/8706, for instance. An object of the present invention is to provide a novel for mounting a cage to a lifting boom of a rock drilling rig so as to enable the use of and access to the cage to prevent at least some of the disadvantages of the known solutions.

[0006] An arrangement according to the invention is characterized in that with respect to each operating boom, each lifting boom is located outermost in a transverse direction of the carrier, that the cage is connected to the lifting boom by means of the vertical axle such that the cage is turnable from the end of the lifting boom substantially to a side of the lifting boom from the vertical axle towards the carrier of the rock drilling rig.

[0007] The idea underlying the invention is that in addition to being connected turnably around a horizontal axle, the cage is also connected turnably around the vertical axle such that the cage may be turned from its normal operating position at the end of the lifting boom, i.e. as a longitudinal extension thereof, to another side of the lifting boom from the end of the lifting boom towards the carrier of the rock drilling rig, whereby when the lifting boom is lowered to its lowest position so as to enable people to step in or out of the cage or equipment and devices to be loaded thereto or unloaded therefrom. In relation to the rest of the booms of the rock drilling rig, the cage resides in a safe location which is easy to access from a side of the rock drilling rig without having to move in the operation area of the other booms and equipment. According to an embodiment of the invention, a separate connection part is provided between the cage and the vertical axle, in which case when the cage is turned to a side of the lifting boom, it moves a longer distance in the longitudinal direction of the lifting boom towards the carrier of the rock drilling rig. According to yet another embodiment, the turning device is a rotating motor, preferably a pressure-fluid-operated rotating motor, the cage being connected

to an axle thereof. According to yet a further embodiment, the cage is in its width direction connected to the vertical axle by its one edge, in which case when the cage is turned to a side of the lifting boom, it settles substantially by its side parallel to the lifting boom and almost comes into contact with the lifting boom. According to yet another further embodiment, with respect to the end of the lifting boom, the cage is connected to be vertically movable so that when the lifting boom is lowered to its lower position, the cage may be moved even closer to the ground level, which makes the cage easier to load and enter or exit.

[0008] An advantage of the invention is that this solution makes the cage safer and easier to use than the known solutions.

[0009] The invention will be described in greater detail in the attached drawings, in which

Figure 1 is a schematic side view showing a rock drilling rig provided with an arrangement according to the invention,

Figure 2 is a schematic top view of the rig according to Figure 1,

Figures 3a and 3b schematically show an alternative embodiment, and

Figures 4a and 4b schematically show another alternative embodiment.

[0010] Figure 1 is a simplified side view showing a rock drilling rig provided with an arrangement according to the invention. The rock drilling rig comprises a carrier 1 and at least one operating boom 2 as well as an actuator 3, in this case a rock drill, arranged in a free end of the operating boom 2. This figure shows three operating booms, but their number may vary according to the type of the rock drilling rig. Further, the actuator arranged in the operating boom may by no means also be e.g. an indexable bolting apparatus or other equipment for use in the actual operation.

[0011] The operating boom 2 usually consists e.g. of one or two boom sections that may be moved by appropriate joints in order to bring an actuator to a given desired position, or it may also be telescopically extended or contracted as shown in the figure. As shown in the figure, the telescopically extendable and contractable boom may comprise three boom parts movable with respect to one another in their longitudinal direction. The number of boom parts may vary, and they are mounted so that a boom part, usually the strong-

est and thickest one, provided at one end of the boom is connected to the carrier 1 of the rock drilling rig while a boom part at the other end of the boom is connected to the actuator 3. The structure and operation of operating booms and different actuators thereof as well as of actuators for use in rock drilling are obvious per se to those skilled in the art, so they are not described in detail in the figure or herein.

[0012] Further, as shown in Figure 1, the rock drilling rig comprises two lifting booms 4 and 5 which by way of example are formed from three boom parts 4a to 4c and 5a to 5c and which are telescopically extendable and contractable, the boom parts 4c and 5c at the free ends of the lifting booms 4 and 5 being provided with cages 6 and 7. In connection with various tasks, the cages may be used for hoisting people and tools or equipment to a desired position. Instead of telescopic booms, the booms may also be articulated booms wherein a boom part facing the cage is directed in the manner shown in Figure 1 so that the cage is in its normal operating position located from the end of the boom forward of the rock drilling rig.

[0013] The lifting booms 4 and 5 are mounted at the front part of the carrier 1 such that with respect to the operating booms 2 they are located outermost in the transverse direction of the carrier 1, and the operating booms 2 reside at the front part of the carrier 2 therebetween.

[0014] The lifting booms 4 and 5 shown in Figure 1 are by their one end connected to the carrier by vertical joints 8. The lifting booms point to the operating direction of the rock drilling rig, i.e. forward, and they may be turned in the horizontal direction with respect to the vertical joints 8. Further, the end of the lifting booms facing the carrier is provided with horizontal joints 9 to enable the lifting booms 4 and 5 to be lifted and lowered in the vertical direction. The lifting booms are turned with respect to the joints 8 and 9 by means of first actuators 10, i.e. hydraulic cylinders, for instance.

[0015] The cages 6 and 7, in turn, are connected to ends of the lifting booms facing away from the carrier of the rock drilling rig by means of horizontal joints 11 which enable the cages to be turned with respect to the lifting booms 4 and 5 by second actuators 12, typically hydraulic cylinders. The lifting booms are further provided with devices known per se and obvious to those skilled in the art that are used for controlling other actuators in accordance with the vertical turning of the lifting booms so that the cages remain in a

horizontal position irrespective of motions of the lifting booms.

[0016] In Figure 1, one lifting boom 5 is shown uplifted and in its operating position, while the other lifting boom 4 is almost in a horizontal position.

[0017] Figure 2 is a schematic top view showing the rig according to Figure 1. It shows how the cages 6 and 7 are further connected to the ends of the lifting booms facing away from the carrier of the rock drilling rig by means of vertical axles 13. This enables the cages to be turned in the transverse direction of the lifting booms 4 and 5 and thus in the horizontal direction, to another side of the lifting booms e.g. about 150 degrees from the normal operating position of the cages 6 and 7, and most preferably substantially 180 degrees such that the cage in its substantially longitudinal direction is parallel to the lifting boom. The cage has then been turned from its vertical axle 13 towards the carrier 1 of the rock drilling rig. The vertical axles 13 are located between the horizontal joints 11 and the cages 6 or 7, respectively, in which case the cages always remain in a horizontal position. As distinct from Figure 1, in Figure 2 the cage 6 of the lifting boom 4 is shown in a turned position while the cage 7 of the lifting boom 5 is shown in its normal operating position.

[0018] When the lifting booms 4 and 5 are with respect to the operating booms s located outermost in the transverse direction of the carrier 1, the cages 6 and 7 are easily brought to a position wherein they are located aside from the operating booms 2 and their operating area and wherein the cages 6 and 7 are easy and safe to enter and exit.

[0019] An intermediate support 14 shown in the figure may be provided between the vertical axle 13 and the cage, one end of the intermediate support 14 being connected to the vertical axle 13 and the other end to the cage. When the cage is turned around the vertical axle 13, it simultaneously turns to a distance from the vertical axle and, simultaneously, from the end of the lifting boom towards the carrier of the rock drilling rig. At the same time, the cage moves farther away from the other booms and devices, to a safer location. When, in connection with a telescopic boom or another boom solution, the outermost boom part of the lifting boom which is connected to the cage is also moved towards the carrier of the rock drilling rig, the cage moves even closer to the carrier of the rock drilling rig.

[0020] In order to turn the cage, a hydraulic motor connected to the

horizontal joint 11 is most preferably used as its turning device 15. The cage or its intermediate support 14, in turn, is connected to an axle operating as the vertical axle 13 of the hydraulic motor, to be turnable therewith. A reliable turning device enabling the turning angle of the cage to become sufficiently large is thus achieved in an easy and simple manner. Instead of a hydraulic motor, it is of course also possible to use other known turning device solutions, such as a hydraulic cylinder provided with a multiplier, or the like.

[0021] In order to bring the cage as parallel to the lifting boom as possible, the intermediate support 14 is preferably connected by its one end to the cage on the side facing the lifting boom, i.e. on the rear side, in the width direction substantially with respect to one edge. In such a case, as can be seen with respect to the cage 6, the cage settles almost in parallel to the lifting boom. Preferably, this solution is used when the lifting boom is mounted on one side of the rock drilling rig. Thus, when mounting cages on opposite sides, it is advantageous to mount them as mutual mirror images, in which case each cage turns to an outer side of the lifting boom, to a location which for the user is safer than the known solutions.

[0022] Figures 3a to 4b schematically show details of some alternative embodiments.

[0023] Figures 3a and 3b are top views showing a solution wherein the cage 6 is mounted substantially in immediate contact with the vertical axle 13. In Figure 3a, the cage is in a normal operating position while in Figure 3b the cage has been turned to a side of the lifting boom 3.

[0024] Figures 4a and 4b are top views showing a solution wherein the cage 6 is mounted to the vertical axle 13 by the intermediate support 14. In this embodiment, the intermediate support 14 and the cage 6 are interconnected by means of another vertical axle 16 provided with a turning device 17 therein, preferably a hydraulic cylinder, which enables the cage to be turned with respect to the intermediate support 14 in its transverse direction. In Figure 4a, the cage is in a normal operating position while in Figure 4b the cage has been turned to another side of the lifting boom 3. In this embodiment, the same lifting boom construction may be used on both sides of the rock drilling rig.

[0025] The drawings and the related description are only intended to illustrate the idea of the invention. The details of the invention may vary within

the scope of the claims. Consequently, the cage may be mounted to the lifting boom by employing different mounting manners and points of the cage both in its width and height directions, as long as it is possible to turn the cage from its normal operating position to a side of the lifting boom. Similarly, the cage may be provided with one, two or more mounting points for a lifting boom.

Claims

1. A rock drilling rig comprising a carrier (1) whose front part is provided with one or more operating booms (2) whose one end is provided with an actuator (3), and at least one lifting boom (4; 5) connected by joints (8, 9) to the front part of the carrier vertically and horizontally turnably, as well as first actuators for turning the lifting boom (4; 5), and wherein one end of the lifting boom (4, 5) is provided with a cage (6; 7) mounted vertically with respect to the lifting boom (4; 5) and turnably around a horizontal joint (11), as well as a second actuator for turning the cage (6; 7) in relation to vertical turning of the lifting boom (4; 5) so that the cage (6; 7) remains in a substantially horizontal position irrespective of a vertical angle of the lifting boom (4; 5), as well as a vertical axle (13) and a turning device (15) for turning the cage in a transverse direction of the lifting boom (4; 5), characterized in that with respect to each operating boom (2), each lifting boom (4; 5) is located outermost in a transverse direction of the carrier (1), that the cage (6; 7) is connected to the lifting boom (4; 5) by means of the vertical axle (13) such that the cage (6; 7) is turnable from the end of the lifting boom (4; 5) substantially to a side of the lifting boom (4; 5) from the vertical axle (13) towards the carrier (1) of the rock drilling rig.

2. A rock drilling rig as claimed in claim 1, characterized in that the cage (6; 7) is connected to the vertical axle (13) on its side facing the lifting boom (4; 5) in its width direction substantially by its one edge so that the cage (6; 7) is turnable to a side of this edge of the cage (6; 7) facing the lifting boom (4; 5).

3. A rock drilling rig as claimed in claim 1 or 2, characterized in that the turning device (15) is a rotating motor connected to the horizontal joint (11), that the vertical axle (13) is an axle of the rotating motor, and that the cage (6; 7) is connected to the axle of the rotating motor to be turnable therewith.

4. A rock drilling rig as claimed in any one of the preceding claims, characterized in that an intermediate support (14) is provided between the cage (6; 7) and the vertical axle (13) so that the cage (6; 7) is turnable to a side of the lifting boom (4; 5) to a distance from an end of the lifting boom (4; 5) and from the vertical axle (13) towards the carrier (1) of the rock drilling rig.

5. A rock drilling rig as claimed in claim 4, characterized in that the intermediate support (14) is mounted with respect to the cage (6; 7) turnably by its end facing the cage around another vertical axle (15).

6. A rock drilling rig as claimed in any one of the preceding claims, characterized in that the front part of the rock drilling rig is provided with two lifting booms (4; 5) which are both located outermost on their own side, the operating booms (2) residing therebetween.

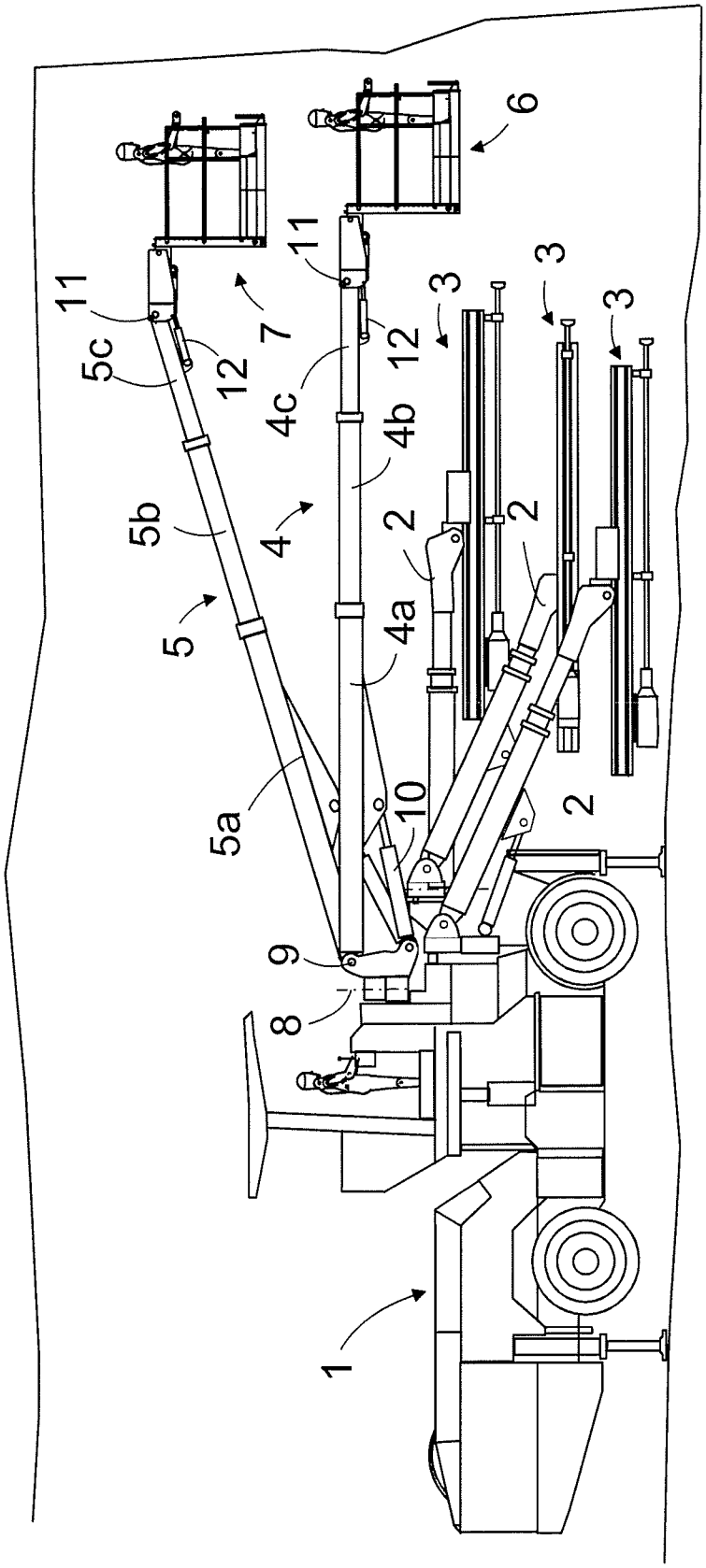

FIG. 1

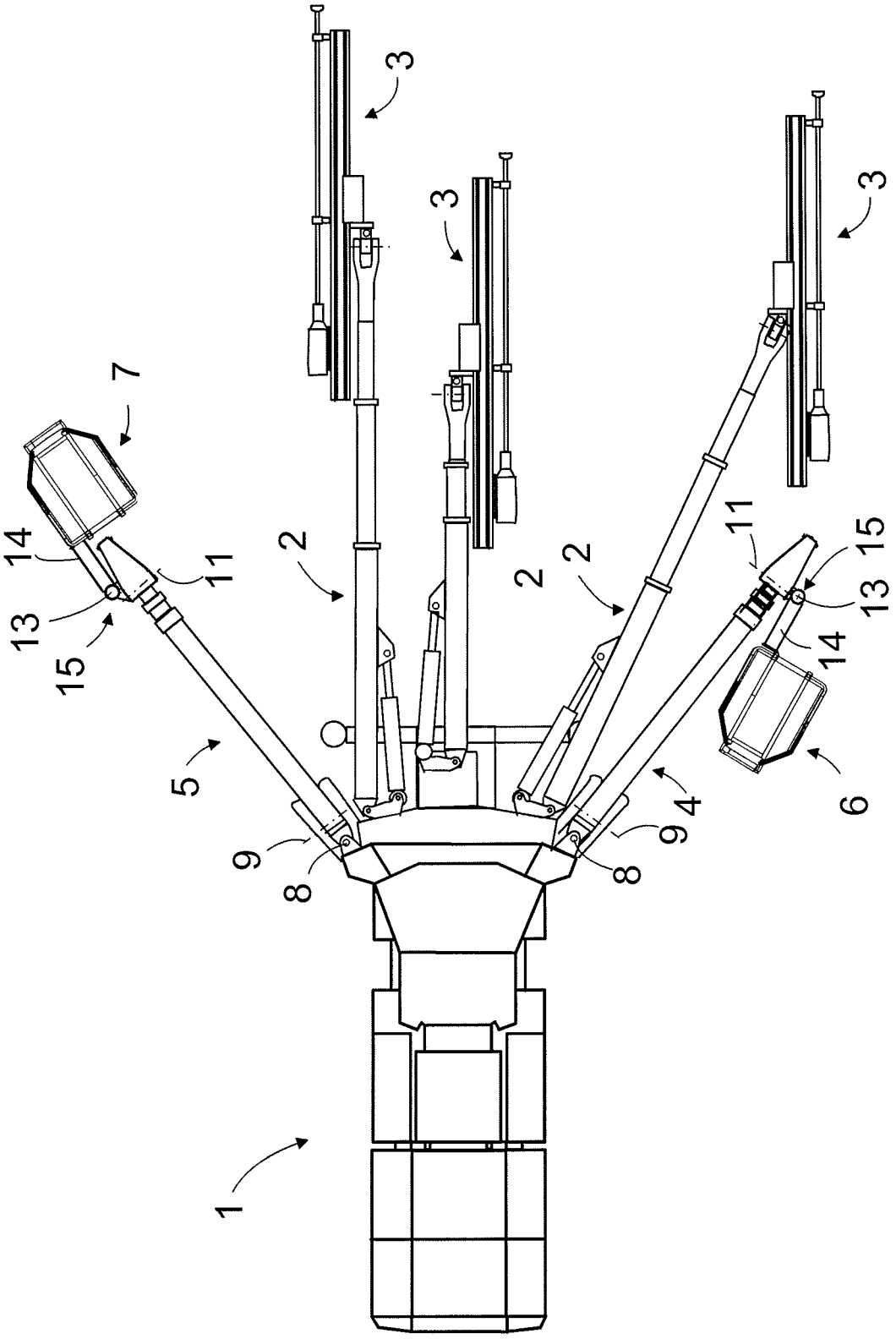

FIG. 2

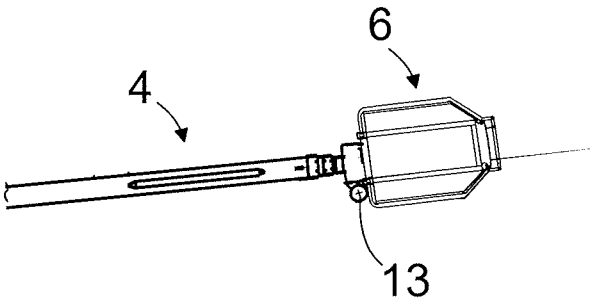

Fig. 3a

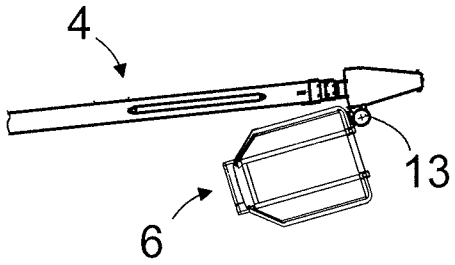

Fig. 3b

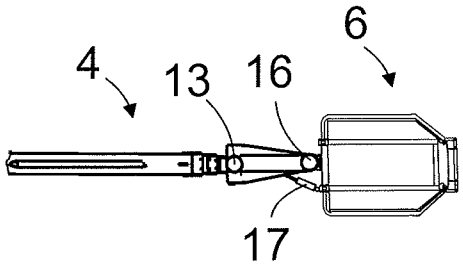

Fig. 4a

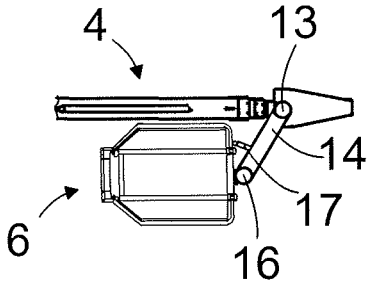

Fig. 4b

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC: B66F, E21 B, E2 1C

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

FI, SE, NO, DK

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

EPO-Internal, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 0181706 A1 (ATLAS COPCO ROCK DRILLS AB et al.) 01 November 2001 (01.11.2001) abstract; page 2, lines 3 - 26; figures 1 - 5	1 - 6
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A	WO 0120117 A1 (SANDVIK TAMROCK OY et al.) 22 March 2001 (22.03.2001) abstract; page 1, lines 1 - 12; page 2, line 32 - page 3, line 29; page 4, line 23 - page 5, line 20; page 6, lines 9 - 25; page 7, lines 1 - 7 and 13 - 16; claims 1 - 7; figures 1 - 4	1 - 6
A	WO 9961748 A1 (SANDVIK TAMROCK OY et al.) 02 December 1999 (02.12.1999) abstract; page 2, line 15 - page 3, line 20; page 4, line 22 - page 6, line 8; page 6, lines 19 - 27; page 7, lines 7 - 13; claims 1 - 8; figures 1a - 2	1 - 6

☐ 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	Date of mailing of the international search report
01 March 2012 (01.03.2012)	06 March 2012 (06.03.2012)

Name and mailing address of the ISA/FI	Authorized officer
National Board of Patents and Registration of Finland P.O. Box 1160, FI-00101 HELSINKI, Finland	Mikko Ruokonen
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INTERNATIONAL SEARCH REPORT
Information on patent family members

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