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(54) A ROCK SPLITTER SYSTEM AND A METHOD FOR SPLITTING ROCK

(57) A rock splitter device and a method for splitting rock are disclosed herein. The rock splitter device is attached to an arm (20) configured for a rock drill. The arm (20) comprises an upper arm rail (21) and a lower arm rail (22). The rock drill (10) is configured to travel along the upper arm rail (21) in a first trajectory parallel to the arm (20), and to drill a hole in the direction of the arm (20).

The rock splitter device is connected to the lower arm rail (21) via a tilting device (31). When the rock drill (10) is used, a rock splitter (30) is tilted away from the operating space of the rock drill. Alternatively, when the rock splitter (30) is used, the rock drill (10) is retracted to a back position and the rock splitter (30) operates in the same trajectory as the rock drill (10).

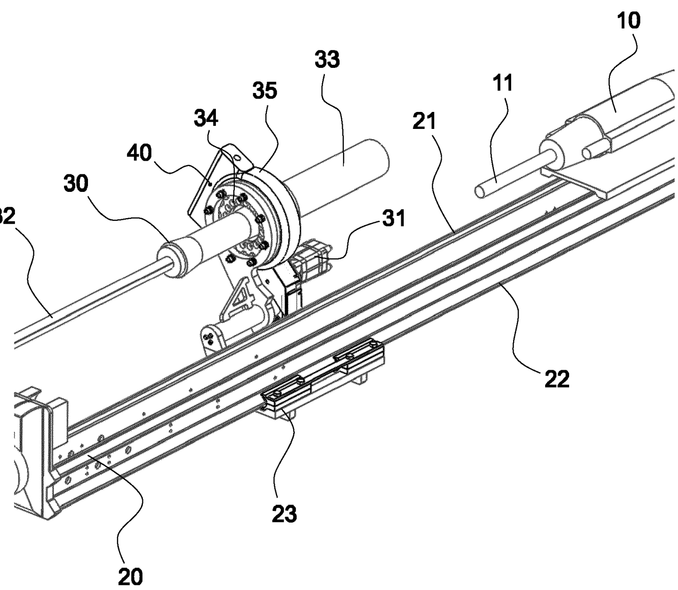

Fig. 1

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Description

BACKGROUND

[0001] This disclosure relates to mining equipment and/or rock drilling and splitting equipment. In mining or construction sites, rocks are typically split by first drilling a hole and inserting a rock splitter into said hole.

[0002] The rock splitter may be a hydraulic splitter, a Darda splitter, a piston splitter or any other type of hydraulic tool. It is used in demolition jobs which involve breaking large blocks of concrete or rocks. Application examples are large rock demolition sites like tunnelling sites or building foundation sites.

[0003] One example of a Darda splitter comprises two wedges which are inserted in a pre-drilled hole and a hydraulic cylinder driven by a hydraulic power pack. One example of piston splitters consists of one hydraulic power pack and one or more cylinders comprising one or multiple pistons on a cylinder body with connecting hoses between the power pack and the cylinders. Piston splitters have been used for demolition of rocks in building foundations, tunnels, and zoo areas, as well as for shaft digging, trench work and quarrying. Large size piston splitters, Darda splitters or wedge splitters may be mounted on an excavator for more efficient demolition.

[0004] Environmental regulations regarding noise, vibration, dust or flying rock increase the demand for hydraulic rock or concrete splitting across the world.

SUMMARY

[0005] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the detailed description. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. Furthermore, the claimed subject matter is not limited to implementations that solve any or all disadvantages noted in any part of this disclosure.

[0006] A rock splitter device and a method for splitting rock are disclosed hereinafter. The rock splitter device is attached to an arm configured for a rock drill. The arm comprises an arm rail having an upper arm rail and a lower arm rail. The rock drill is configured to travel along the upper arm rail in a first trajectory parallel to the arm, and to drill a hole in the direction of the arm. The arm rail comprises a lower arm rail positioned at other side than the upper arm rail. The lower arm rail may be configured to provide rigidity to the arm. In many applications, the lower arm rail is not used for connecting any rock breaking devices. In this embodiment, the lower arm rail carries the rock splitter device.

[0007] The rock splitter device is connected to the lower arm rail via a tilting device. When the rock drill is used, the rock splitter is tilted away from the operating space of the rock drill. Alternatively, when the rock splitter is used, the rock drill is retracted to a back position and the rock splitter operates in the same trajectory as the rock drill, being directed into the newly drilled hole and further splitting the rock from the hole. The rock drill and the rock splitter alternate in occupying the operational space. The arm may stay in the same position during drilling and splitting, allowing quick tool changes between the drill and the splitter.

[0008] Attaching the rock splitter device to the lower arm rail enables it to be retrofitted into many existing rock drill configurations. The arrangement increases the usage possibilities for the arm and the rock drill setup. The machinery previously used only for drilling may be used to break large amounts of rock.

[0009] The rock splitting process is clean and well controlled compared to blasting. Rock splitting meets many of the environmental regulations as the rock fracturing may be controlled by the force applied to the rock. The fracture directions may be controlled by selecting the orientation of the rock splitter head. Rock splitting does not cause as much noise or vibrations to the rock as blasting would. The distraction in the environment is mitigated. Rock splitting may be used near urban areas and or near sensitive environment.

[0010] Many of the attendant features will be more readily appreciated as they become better understood by reference to the following detailed description considered in connection with the accompanying drawings. The embodiments described below are not limited to implementations which solve any or all the disadvantages of rock splitting devices or methods.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present description will be better understood from the following detailed description read in light of the accompanying drawings, wherein

FIG. 1 illustrates schematically one exemplary embodiment of a rock drill positioned in a back position on an upper arm rail;

FIG. 2 illustrates schematically one exemplary embodiment of the rock drill positioned in a forward position on the upper arm rail and a rock splitter being tilted away from the rock drilling procedure;

FIG. 3 illustrates schematically one exemplary embodiment of the rock splitter connected to a lower arm rail and in an inactive position;

FIG. 4 illustrates schematically one exemplary embodiment of the rock drill positioned in the back position on the upper arm rail with the rock splitter in a working position;

FIG. 5 illustrates schematically one exemplary embodiment of the rock splitter in the working position;

FIG. 6 illustrates schematically one exemplary embodiment of the rock splitter in the inactive position;

FIG. 7 illustrates schematically one exemplary embodiment of the rock drill positioned in the back position on the upper arm rail, with the rock splitter in the working position; and

FIG. 8 illustrates a flowchart of steps of the method disclosed herein.

[0012] Like reference numerals are used to designate like parts in the accompanying drawings.

DETAILED DESCRIPTION

[0013] The detailed description provided below in connection with the accompanying drawings is intended as a description of the present examples and is not intended to represent the only forms in which the present example may be constructed or utilized. However, the same or equivalent functions and sequences may be accomplished by different examples.

[0014] Although the present examples are described and illustrated herein as being implemented in mining or tunnelling, they are provided as an example and not a limitation. As those skilled in the art will appreciate, the present examples are suitable for application in a variety of different types of rock splitting embodiments.

[0015] FIG. 1 illustrates schematically one exemplary embodiment of a rock drill 10 positioned in a back position on an upper arm rail 21 and a rock splitter 30 is tilted outside the rock drill's 10 operating space. The rock drill 10 moves back and forth along the upper arm rail 21. The rock drill 10 is illustrated partially. In this example, the rock splitter 30 is tilted away from a first trajectory of the rock drill 10. The first trajectory is defined herein as the space occupied by the rock drill 10 during its movement from the back position to a forward position and its return to the back position.

[0016] FIG. 2 illustrates schematically one exemplary embodiment of the rock drill 10 positioned in a forward position on the upper arm rail 21 and the rock splitter 30 is tilted outside the rock drill's 10 operating space. The rock drill 10 may move freely between the examples of FIG. 1 and FIG. 2. In the forward position, the rock drill 10 is actively drilling the rock and, in the back position, the rock drill 10 is retracted from the drilling position along the upper arm rail 21 to a position where it does not hinder using the rock splitter 30 in the first trajectory. The rock splitter 30 is configured to be tilted away from the first trajectory by a tilting device 31, during an active phase of the rock drill 10. Examples of the active phase of the rock drill 10 are when the rock drill 10 drills a hole, or when the rock drill 10 is used for testing or maintenance purposes.

[0017] The rock splitter 30 may be a commercially available rock splitter that is connected to a rock splitter device. The rock splitter device is configured to manipulate and move the rock splitter 30 between an inactive position and a working position. In one embodiment, the rock splitter 30 comprises a splitter head 32 and an actuator mechanism 33 configured to spread the splitter head inside the drilled hole. The rock splitter 30 may be a hydraulic splitter, a Darda splitter, a piston splitter or any other type of tool configured to split the rock by expanding its elements inside the drilled hole. In one embodiment, the rock splitter 30 is part of the rock splitter device.

[0018] The rock splitter device 30 is attached to a lower arm rail 22 by connecting means 23. In one embodiment, the connecting means 23 is a slide, such as a dovetail slide allowing the rock splitter device to travel along the lower arm rail 22. The lower arm rail 22 is positioned at the other side of the arm 20 than the upper arm rail 21. The lower arm rail 22 is positioned outside the first trajectory. In one embodiment, the lower arm rail 22 is positioned at an opposite side to the upper arm rail 21. In one embodiment, the lower arm rail 22 is positioned at either side of the arm 20. In one embodiment, the lower arm 22 is configured to provide additional rigidity to the arm 20. The definition of directions such as up, down, upper, lower are meant only as an example in the present context. As the arm 20 may be moved or tilted into various positions, the directions may move accordingly. In various embodiments, the arm 20 may be moved to drill holes down, forward, up or to any intermediate position. The present example orientates the arm 20 to drill holes and split rock in forward position and the rock drill 10 is operated on top of the forward-orientated upper arm rail 21.

[0019] When the hole has been drilled, the rock drill 10 is retracted back and the rock splitter 30 is tilted from below, or from the side outside the first trajectory, to occupy the same trajectory as the rock drill 10. The rock splitter 30 is moved back and forth along the lower arm rail 22 by means for moving the rock splitter 30 backwards and forwards along the first trajectory. In one embodiment, the means for moving is a longitudinal hydraulic cylinder 70, illustrated in FIG. 7, having a first end fixedly connected to the arm 20 and a second end connected to the connecting means 23 of the rock splitter device. FIG. 7 illustrates schematically one exemplary embodiment of the hydraulic cylinder 70. Movements of the hydraulic cylinder 70 cause the connecting means 23 to travel along the lower arm rail 22. Alternatively, the means for moving may be any actuating device configured to provide backwards and forwards movement for the rock splitter 30.

[0020] FIG. 7 illustrates schematically one exemplary embodiment of the rock drill 10 positioned in the back position on the upper arm rail 21, with the rock splitter 30 in the working position and the rock splitter 30 extended through an opening 60. The opening 60 may provide support for a splitter head 32. In one embodiment, the opening 60 comprises a surface made of polyoxymethylene (POM), configured to provide low friction and dimensional stability.

[0021] FIG. 4 illustrates schematically an isometric view from above of one exemplary embodiment of the rock drill 10 positioned in the back position on the upper arm rail 21 with the rock splitter 30 in a working position. FIG. 5 illustrates an isometric view from below of the same embodiment in the working position and FIG. 3 in the inactive position. The rock splitter 30 moves, by means of the rock splitter device and the tilting device 31, between the working position and the inactive position. In the inactive position, the rock splitter 30 and the whole rock splitter device is tilted away from the first trajectory, allowing operation of the rock drill, as illustrated in Figures 1 - 3. In the working position, the splitter head 32 operates on the same trajectory, or on a second trajectory, as a drill bit 11, if the arm 30 has not been moved during the switching of the rock drill 10 and the rock splitter 30. The arm 20 may be pushed against the rock surface. The arm may lean against the rock to be broken using a bumper 24 arranged in a front portion of the arm 20. The bumper 24 is made of a material having sufficient friction against the rock, such as rubber. The bumper 24 makes it easier to maintain the position of the arm 20. At the extreme end of the upper arm rail 21 is an arm head, comprising an opening 60 for the drill bit 11. The splitter head 32 may occupy the same opening 60 during operation. The working position of the rock splitter 30 has a back position and a splitting position. The rock splitter 30 is tiltable only in the back position. The splitting position occurs when the rock splitter head 32 meets the drilled hole at its bottom or at a suitable depth.

[0022] FIG. 6 illustrates schematically a front view of one exemplary embodiment of the rock splitter in the inactive position. In one embodiment, the rock splitter device is attached to the tilting device 31 by a flexible mounting 34. The flexible mounting 34 protects the tilting device 31 mechanism from impacts caused by the rock splitter 30 and the fracturing rock. Vibrations and impacts occur when the rock splitter head 32 is inserted into the drilled hole, during expansion of the rock splitter head 32 and during fracturing, when separating rocks or larger boulders may scrape against or fall onto the rock splitter head 32. In one embodiment, the flexible mounting 34 is arranged into a collar 35 surrounding the rock splitter 30. The rock splitter 30 may be attached to a circular insert that is further connected into the collar 35. The collar 35 may comprise flexible material supporting the insert, such as rubber flanges at both sides of the insert. The flexible material is tightened against the insert by a series of bolts or other tightening means.

[0023] In one embodiment, the orientation of the splitter head 32 is rotatable to control the direction of the rock fracturing. In one embodiment, the rotating function is implemented by the rock splitter 30, being integrated, for example, into the collar 35 or into the flexible mounting 34. The splitter head 32 may be any suitable type for splitting rock, concrete, or other hard materials.

[0024] In one embodiment, a camera 40 is attached to the rock splitter 30 to provide an improved view for the user. The camera may be connected to the collar 35 for an improved view. The collar 35 may comprise multiple sizes and shapes. In one embodiment, the upper portion of the collar 35 is reduced in size to provide an improved view for the user.

[0025] In one embodiment, the movements of the rock splitter 30 are monitored by inductive sensors 36. Exemplary positions of the inductive sensors 36 are illustrated in FIG. 3 and FIG. 4. The inductive sensors 36 are configured to detect when the rock splitter 30 is in a back position, a forward position, a working position, or an inactive position. Other sensors or sensor types may be applied to control the movements. The sensor helps prevent the rock splitter 30 and the rock drill 10 from colliding. The rock splitter device may comprise control electronics and/or an interface for the machine controlling the rock drill 10. The rock splitter device and/or the control electronics may comprise a memory for storing a computer program and a processor for executing the instructions of the computer program. In one application example, one inductive sensor 36 detects when the rock drill 10 is in a back position, and the rock splitter device defines that the first trajectory is clear for the rock splitter 30. In one application example, one inductive sensor 36 detects that the rock splitter 30 is in a back position, and the rock splitter device defines that the rock splitter 30 may be tilted away from the first trajectory. If the rock splitter were to be tilted too soon, the rock splitter head 32 could still be in the hole or in the opening 60, and this would cause damage to the rock splitter head 32. In one application example, one inductive sensor 36 detects that the rock splitter 30 is in the fully tilted position, completely away from the first trajectory, and the rock splitter device defines that the rock drill 10 may be used for drilling the rock. In one embodiment, the control electronics use an image captured by the camera 40 to confirm the status of the inductive sensor 36. The inductive sensor 36 operates reliably under difficult conditions, wherein problems caused by debris are mitigated.

[0026] In one embodiment, the switching between the rock drill 10 and the rock splitter 20 is automated and controlled by the control electronics. The control electronics may be positioned in the rock splitter device housing or may be part of a distributed control system at least partially integrated into a user control panel. In one embodiment, the user may control the steps of switching between the rock drill 10 and the rock splitter 20. The control electronics may prohibit the user from making any dangerous movements that could cause damage to the rock drill device or the rock splitter 20.

[0027] In one alternative embodiment, the connecting means 23 is a fixed connection and the rock splitter device comprises means for moving the rock splitter 30 along the first trajectory. In one example, the rock splitter device comprises means for moving the rock splitter along an upper arm rail 21. The rock splitter device, beingly fixedly attached to the lower arm rail 22, is configured to turn the rock splitter 30 into the first trajectory. The rock splitter device comprises a support structure configured to support the rock splitter 30 while the support structure removably connects to the upper arm rail 21. The support structure comprises means for moving the rock splitter 30. The support structure comprises at least two portions configured to lean against the upper arm rail 21; a first portion connected to the tilting device 31 that is stationary on the upper arm rail 21 and a second portion configured to move back and forth along the upper arm rail 21 while carrying the rock splitter 30. The second portion comprises the flexible mounting 34. In one embodiment, the first portion and the second portion are connected by the means for moving, for example by the hydraulic cylinder 70. Alternatively, the means for moving may be any actuating device configured to provide movement backwards and forwards along the upper arm rail 21.

[0028] The lower arm rail 22 may be arranged to the arm 20 to provide strength and rigidity. The rock splitter device may be retrofitted to many currently available rock drill assemblies having the upper arm rail 21 and the lower arm rail 22. The connecting means 23 may be modified or replaced to accommodate various lower arm rail 22 profiles. In one embodiment, the connecting means 23 is configured to any lower part of the arm, provided that the connection is out of the first trajectory. In one embodiment, the rock splitter device is part of the rock drill assembly and the arm 20.

[0029] FIG. 8 illustrates a flowchart of steps of the method disclosed herein. Step 80 comprises operating the rock drill 10 along an arm 20 having an upper arm rail 21 and a lower arm rail 22. The rock drill 10 may be used according to normal procedure - as in step 81 - drilling the hole by the rock drill 10 along the upper arm rail 21. The rock drill 10 may drill a single hole or multiple holes. The rock splitter device benefits from drilling only one hole at a time, as the rock splitter 30 may be inserted into the newly drilled hole without the need for aiming the rock splitter head 32 as the arm 20 remains in the same position. The rock splitter head 32 may occupy the same second trajectory as the rock drill bit 11.

[0030] Step 82 comprises retracting the rock drill 10 to the back position. In one embodiment, the inductive sensor 36 detects the back position of the rock drill 10. Step 83 comprises tilting the rock splitter device to a working position and to the same trajectory as the drill bit 32 of the rock drill 10. The rock splitter device is attached to the lower arm rail 22 during the manoeuvre. Step 84 comprises moving the rock splitter device forward to the drilled hole. Step 85 comprises splitting the rock using the rock splitter 30, for example by expanding the rock splitter head 32 inside the drilled hole. Step 86 comprises retracting the rock splitter device to the back position. In one embodiment, the inductive sensor 36 detects the back position of the rock splitter 30. Step 87 comprises tilting the rock splitter device to the inactive position, allowing the rock drill 10 to operate. In one embodiment, the inductive sensor 36 detects the inactive position of the rock splitter device, confirming that the first trajectory is free for the rock drill 10.

[0031] A rock splitter device is disclosed herein, comprising a rock splitter configured to be attached to an arm configured for a rock drill. The rock splitter device is configured to be attached to the arm comprising an upper arm rail and a lower arm rail, wherein the rock drill is configured to travel along the upper arm rail in a first trajectory parallel to the upper arm rail, and to drill a hole in the direction of the upper arm rail, and the lower arm rail is positioned at the other side to the arm than the upper arm rail; and the rock splitter device is configured to be attached to the lower arm rail. In one embodiment, the rock splitter is configured to tilt, using a tilting device, between a working position and an inactive position, wherein the working position is in the first trajectory and the inactive position is outside said first trajectory. In one embodiment, the rock splitter device comprises a camera configured to monitor the rock splitter. In one embodiment, the rock splitter is connected to a tilting device by a flexible mounting. In one embodiment, the rock splitter is configured to operate in a working position in the same trajectory as a drill bit, wherein a rock splitter head is configured to enter a drilled hole when the arm remains in the same position as during the drilling of said hole. In one embodiment, the movement of the rock splitter device is monitored by at least one inductive sensor. In one embodiment, the at least one inductive sensor is configured to detect when the rock splitter is in a back position. In one embodiment, the at least one inductive sensor is configured to detect when the rock splitter is in a working position or in an inactive position. In one embodiment, a hydraulic cylinder is connected to the arm in a position outside the first trajectory, and the rock splitter is configured to be moved along the lower arm rail by a hydraulic cylinder. In one embodiment, the rock splitter device comprises a bumper at an extreme end of the arm, configured to maintain the arm in the same position during drilling and splitting.

[0032] Alternatively or in addition, a rock splitter device is disclosed, the device being attached to an arm configured for a rock drill, wherein the arm comprises an arm rail having an upper arm rail and a lower arm rail, and wherein the rock drill is configured to travel along the upper arm rail in a first trajectory parallel to the arm, and to drill a hole in the direction of the arm; said arm rail comprising a lower arm rail positioned at the other side than the upper arm rail configured to carry the rock splitter assembly. In one embodiment, the rock splitter device is configured to be tilted, using a tilting device, away from the trajectory of the rock drill configured to operate on the upper arm rail. In one embodiment, the rock splitter device comprises a camera. In one embodiment, the rock splitter device is connected to a tilting device by a flexible mounting. In one embodiment, the rock splitter device is configured to operate in a working position in the same trajectory as a drill bit, wherein the rock splitter enters a drilled hole when the arm is held in the same position as during the drilling of the hole. In one embodiment, the movements of the rock splitter device are monitored by inductive sensors. In one embodiment, the rock splitter device is configured to be moved along the lower arm rail by a hydraulic cylinder connected to a lower position on the arm.

[0033] Alternatively, or in addition, a method for splitting rock is disclosed herein. The method comprises: operating a rock drill along an arm rail having an upper arm rail and a lower arm rail; drilling a hole, using the rock drill, along the upper arm rail; retracting the rock drill to a back position; tilting the rock splitter device to a working position and to the same trajectory as a drill bit of the rock drill, while being attached to the lower arm rail; moving the rock splitter device forward to the hole; splitting the rock using a rock splitter; retracting the rock splitter device; and tilting the rock splitter device to an inactive position, allowing the rock drill to operate. In one embodiment, the method comprises detecting, by at least one inductive sensor, when the rock splitter is in a back position. In one embodiment, the method comprises detecting, by at least one inductive sensor, when the rock splitter is in a working position or in an inactive position. In one embodiment, the method comprises tilting the rock splitter, using a tilting device, between a working position and an inactive position, wherein the working position is in the first trajectory and the inactive position is outside said first trajectory. In one embodiment, the method comprises moving the rock splitter in a working position using a hydraulic cylinder connected to the lower arm rail in a position outside the first trajectory.

[0034] Alternatively or in addition, a method for splitting rock comprises at least one of the following steps: operating a rock drill along an arm rail having an upper arm rail and a lower arm rail; drilling a hole along the upper arm rail; retracting the rock drill to a back position; tilting the rock splitter device to a working position and to the same trajectory as a drill bit of the rock drill, while being attached to the lower arm rail; moving the rock splitter device forward to the hole; splitting the rock; retracting the rock splitter device; and tilting the rock splitter device to an inactive position, allowing the rock drill to operate.

[0035] Alternatively, or in addition, the controlling functionality described herein can be performed, at least in part, by one or more hardware components or hardware logic components. An example of a controller or the control electronics for the rock splitting device and/or rock drilling device described hereinbefore is a computing-based device comprising one or more processors which may be microprocessors, controllers, or any other suitable type of processors for processing computer-executable instructions to control the operation of the device in order to control one or more sensors, receive sensor data and utilize the sensor data. The computer-executable instructions may be provided using any computer-readable media that is accessible by a computing-based device. Computer-readable media may include, for example, computer storage media such as memory and communications media. Computer storage media, such as memory, includes volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EPROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other non-transmission medium that can be used to store information for access by a computing device. In contrast, communication media may embody computer-readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave, or other transport mechanism. As defined herein, computer storage media does not include communication media. Therefore, a computer storage medium should not be interpreted to be a propagating signal per se. Propagated signals may be present in a computer storage media, but propagated signals per se are not examples of computer storage media. Although the computer storage media is shown within the computing-based device, it will be appreciated that the storage may be distributed or located remotely and accessed via a network or other communication link, for example, by using a communication interface.

[0036] The apparatus or the device may comprise an input/output controller arranged to output display information to a display device which may be separate from or integral to the apparatus or device. The input/output controller is also arranged to receive and process input from one or more devices, such as a user input device (e.g. a mouse, keyboard, camera, microphone or other sensor).

[0037] The methods described herein may be performed by a software in machinereadable form on a tangible storage medium e.g. in the form of a computer program comprising computer program code means adapted to perform all the steps of any of the methods described herein when the program is run on a computer and where the computer program may be embodied on a computer-readable medium. Examples of tangible storage media include computer storage devices comprising computer-readable media, such as disks, thumb drives, memory etc. and do not only include propagated signals. Propagated signals may be present in a tangible storage media, but propagated signals per se are not examples of tangible storage media. The software can be suitable for execution on a parallel processor or a serial processor such that the method steps may be carried out in any suitable order, or simultaneously.

[0038] Any range or device value given herein may be extended or altered without losing the effect sought.

[0039] Although at least a portion of the subject matter has been described in language specific to structural features and/or acts, it is to be understood that the subject matter defined in the accompanying claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as examples of implementing the claims and other equivalent features and acts are intended to be within the scope of the claims.

[0040] It will be understood that the benefits and advantages described above may relate to one embodiment or may relate to several embodiments. The embodiments are not limited to those that solve any or all of the stated problems or those that have any or all of the stated benefits and advantages. It will further be understood that reference to 'an' item refers to one or more of those items.

[0041] The steps of the methods described herein may be carried out in any suitable order, or simultaneously where appropriate. Additionally, individual blocks may be deleted from any of the methods without departing from the spirit and scope of the subject matter described herein. Aspects of any of the examples described above may be combined with aspects of any of the other examples described to form further examples without losing the effect sought.

[0042] The term 'comprising' is used herein to mean including the method blocks or elements identified, but that such blocks or elements do not comprise an exclusive list and a method or device may contain additional blocks or elements.

[0043] It will be understood that the above description is given by way of example only and that various modifications may be made by those skilled in the art. The above specification, examples and data provide a complete description of the structure and use of exemplary embodiments. Although various embodiments have been described above with a certain degree of particularity, or with reference to one or more individual embodiments, those skilled in the art could make numerous alterations to the disclosed embodiments without departing from the spirit or scope of this specification.

Claims

1. A rock splitter device, comprising:

a rock splitter (30) configured to be attached to an arm (20) configured for a rock drill (10), **characterized in that** the rock splitter device is configured to be attached to the arm (20) comprising an upper arm rail (21) and a lower arm rail (22), wherein the rock drill (10) is configured to travel along the upper arm rail (21) in a first trajectory parallel to the upper arm rail (21), and to drill a hole in the direction of the upper arm rail (21), and the lower arm rail (22) is positioned at the other side to the arm (20) than the upper arm rail (21); and
the rock splitter device is configured to be attached to the lower arm rail (22).

2. A rock splitter device according to claim 1, **characterized in that** the rock splitter (30) is configured to be tilted, using a tilting device (31), between a working position and an inactive position, wherein the working position is in the first trajectory and the inactive position is outside said first trajectory.

3. A rock splitter device according to claim 1 or claim 2, **characterized by** comprising a camera (40) configured to monitor the rock splitter (30).

4. A rock splitter device according to any of the claims 1 to 3, **characterized in that** the rock splitter (30) is connected to a tilting device (31) by a flexible mounting (34).

5. A rock splitter device according to any of the claims 1 to 4, **characterized in that** the rock splitter (30) is configured to operate in a working position in the same trajectory as a drill bit, wherein a rock splitter head (32) is configured to enter a drilled hole when the arm (20) remains in the same position as during the drilling of said hole.

6. A rock splitter device according to any of the claims 1 to 5, **characterized in that** the movement of the rock splitter device is monitored by at least one inductive sensor.

7. A rock splitter device according to claim 6, **characterized in that** the at least one inductive sensor is configured to detect when the rock splitter (30) is in a back position.

8. A rock splitter device according to claim 6 or claim 7, **characterized in that** the at least one inductive sensor is configured to detect when the rock splitter (30) is in a working position or in an inactive position.

9. A rock splitter device according to any of the claims 1 to 8, **characterized in that** a hydraulic cylinder is connected to the arm (20) in a position outside the first trajectory, and the rock splitter (30) is configured to be moved along the lower arm rail (22) by a hydraulic cylinder.

10. A rock splitter device according to any of the claims 1 to 9, **characterized by** comprising a bumper at an extreme end of the arm (20), configured to maintain the arm (20) in the same position during drilling and splitting.

11. A method for splitting rock, comprising:

operating a rock drill (10) along an arm rail hav-

ing an upper arm rail (21) and a lower arm rail (22);
drilling a hole, using the rock drill (10), along the upper arm rail (21);
retracting the rock drill (10) to a back position;
tilting the rock splitter device to a working position and to the same trajectory as a drill bit of the rock drill (10), while being attached to the lower arm rail (22);
moving the rock splitter device forward to the hole;
splitting the rock using a rock splitter (30);
retracting the rock splitter device; and
tilting the rock splitter (10) to an inactive position, allowing the rock drill (10) to operate.

12. A method according to claim 11, **characterized by** detecting, by at least one inductive sensor, when the rock splitter (30) is in a back position.

13. A method according to claim 11 or claim 12, **characterized by** detecting, by at least one inductive sensor, when the rock splitter (30) is in a working position or in an inactive position.

14. A method according to any of the claims 11 to 13, **characterized by** tilting the rock splitter (30), using a tilting device (31), between a working position and an inactive position, wherein the working position is in the first trajectory and the inactive position is outside said first trajectory.

15. A method according to any of the claims 11 to 14, **characterized by** moving the rock splitter (30) in a working position using a hydraulic cylinder connected to the lower arm rail (22) in a position outside the first trajectory.

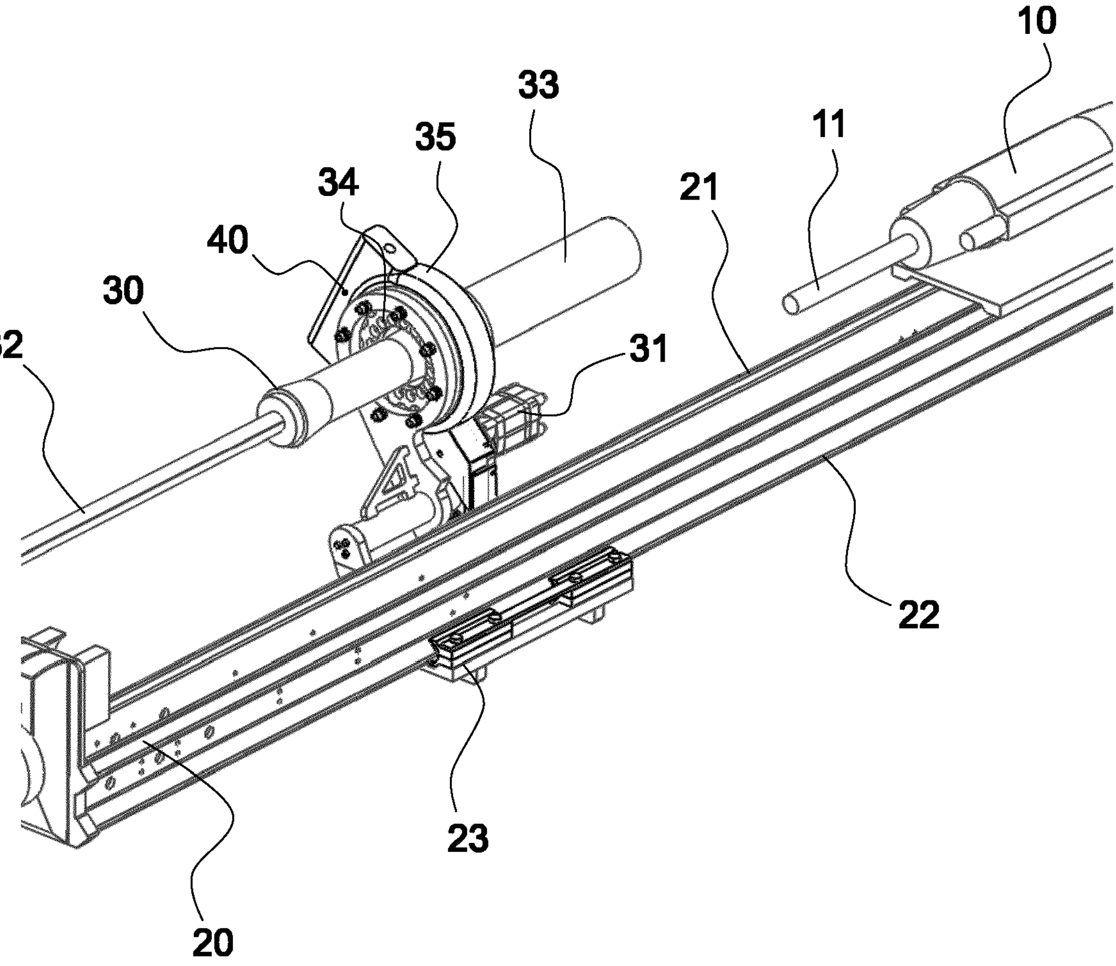

Fig. 1

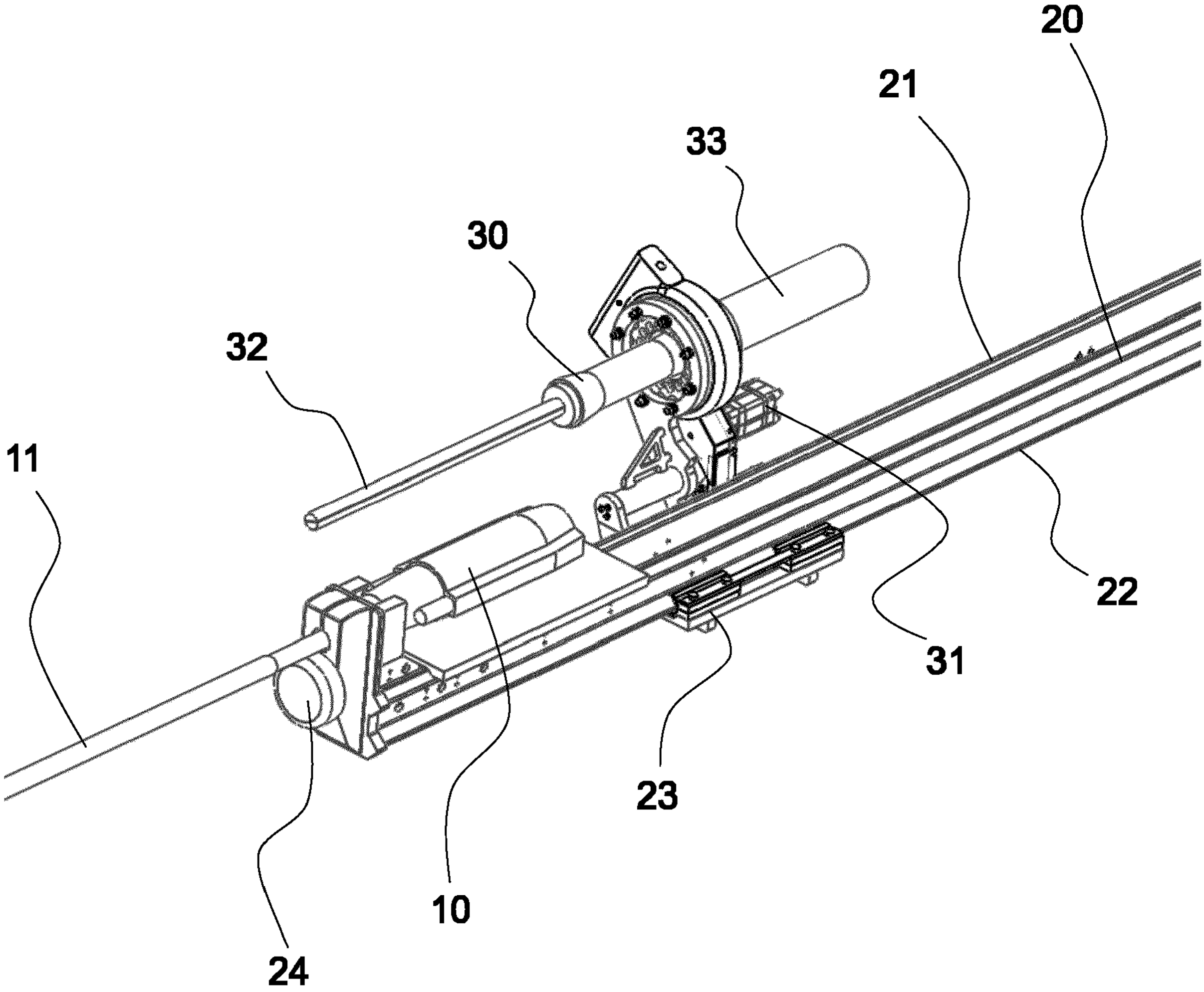

Fig. 2

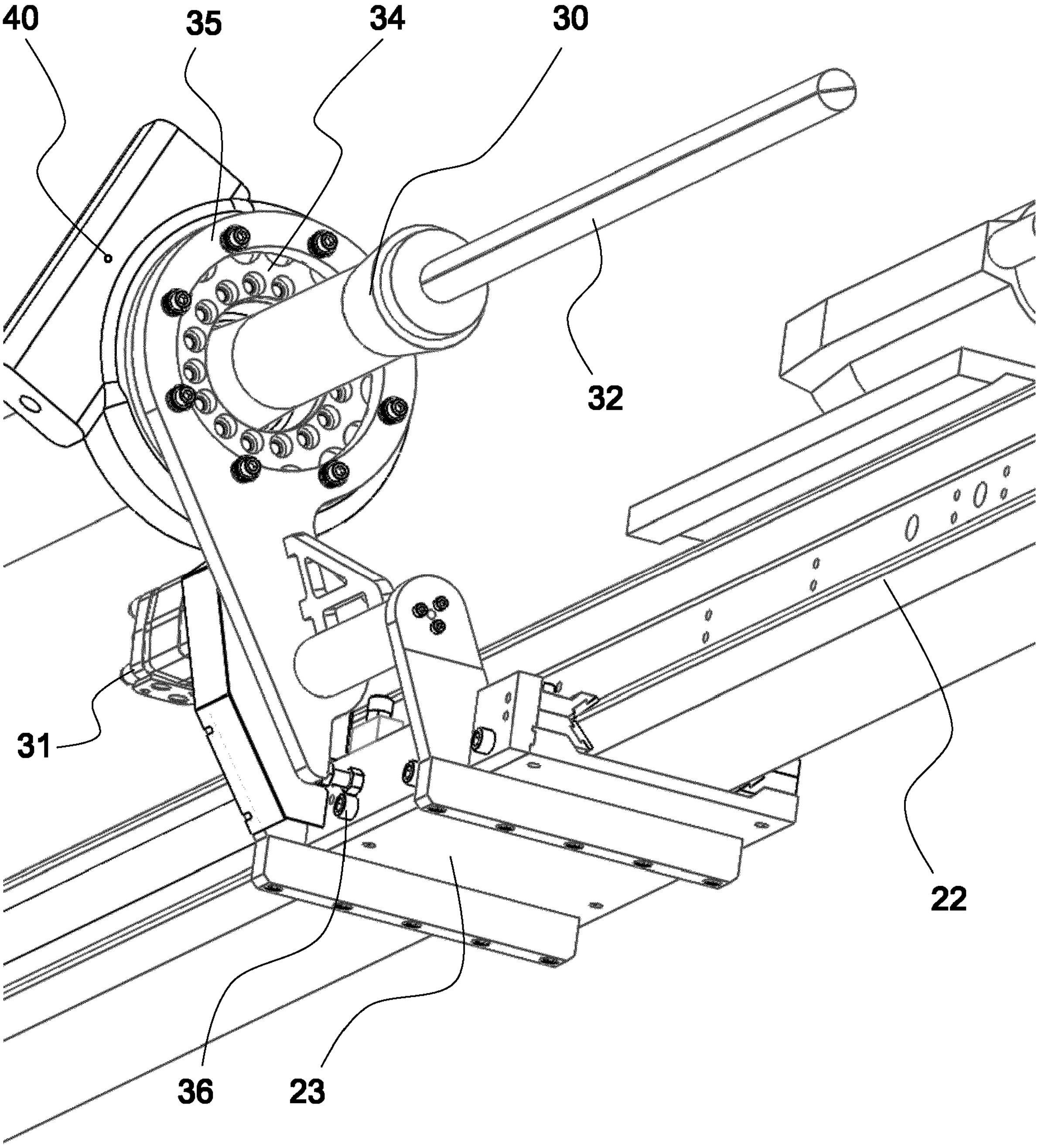

Fig. 3

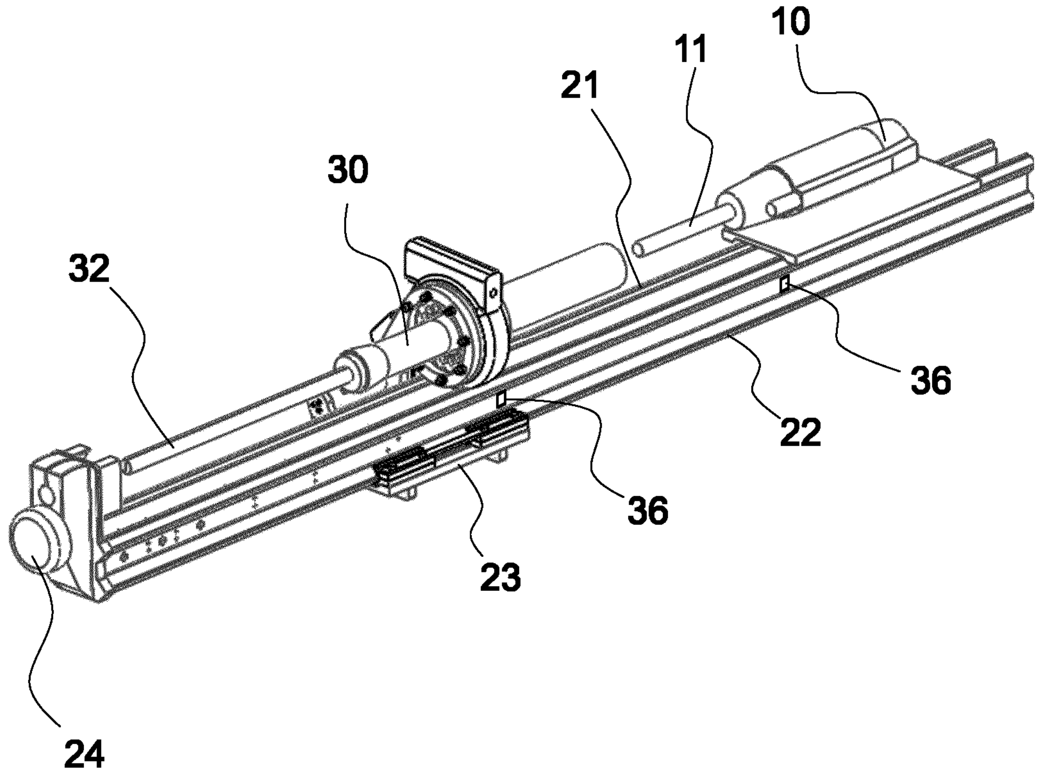

Fig. 4

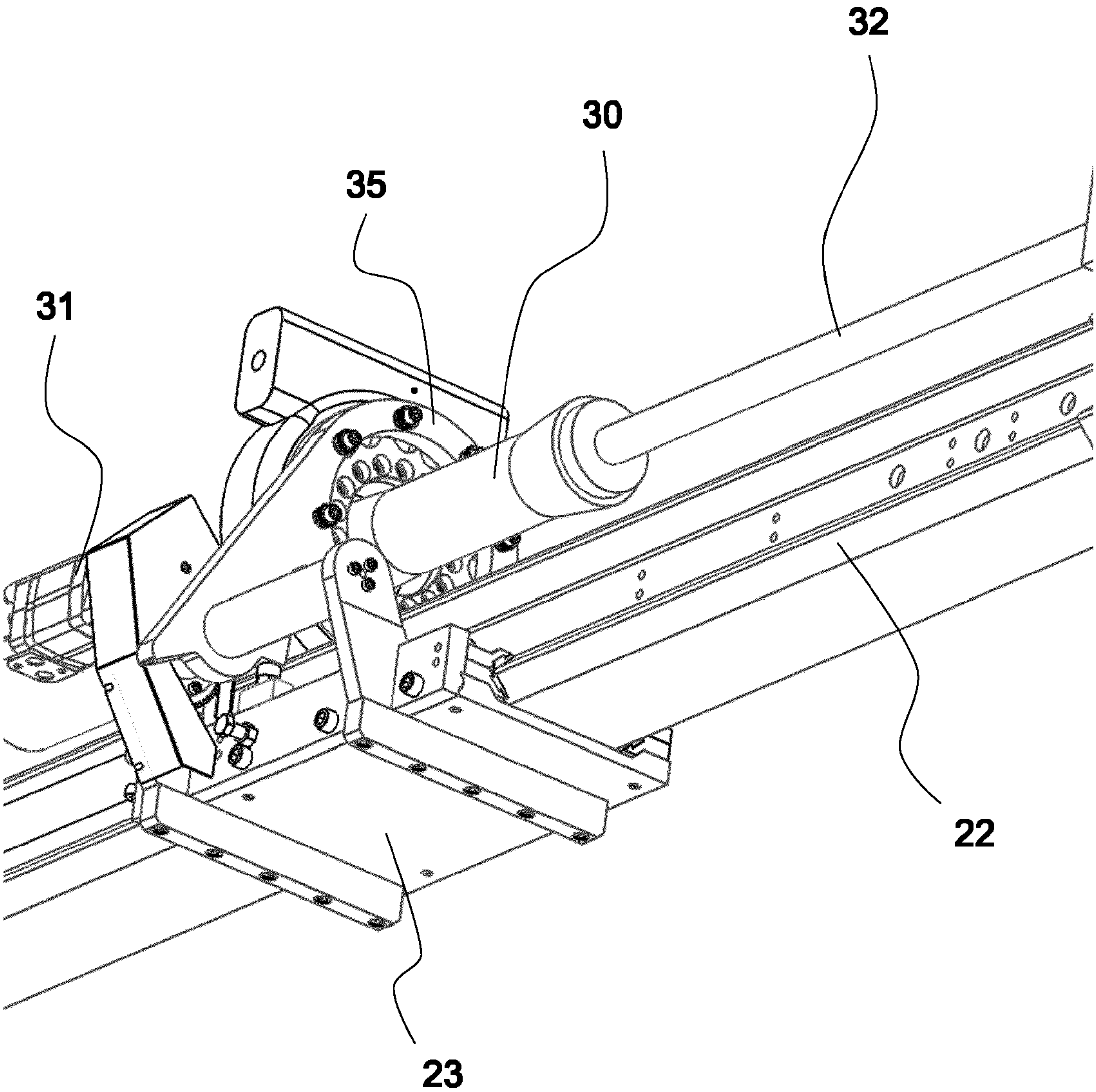

Fig. 5

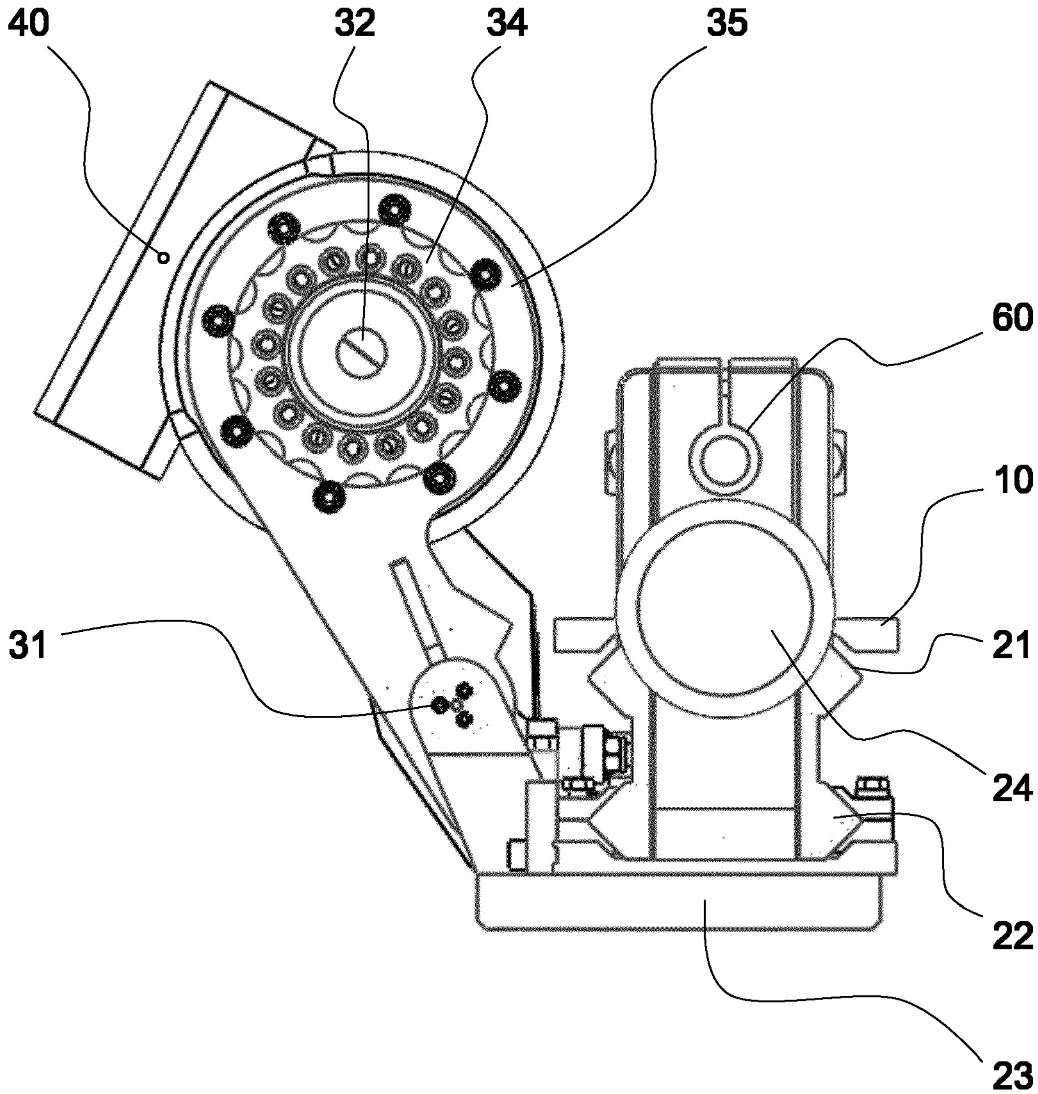

Fig. 6

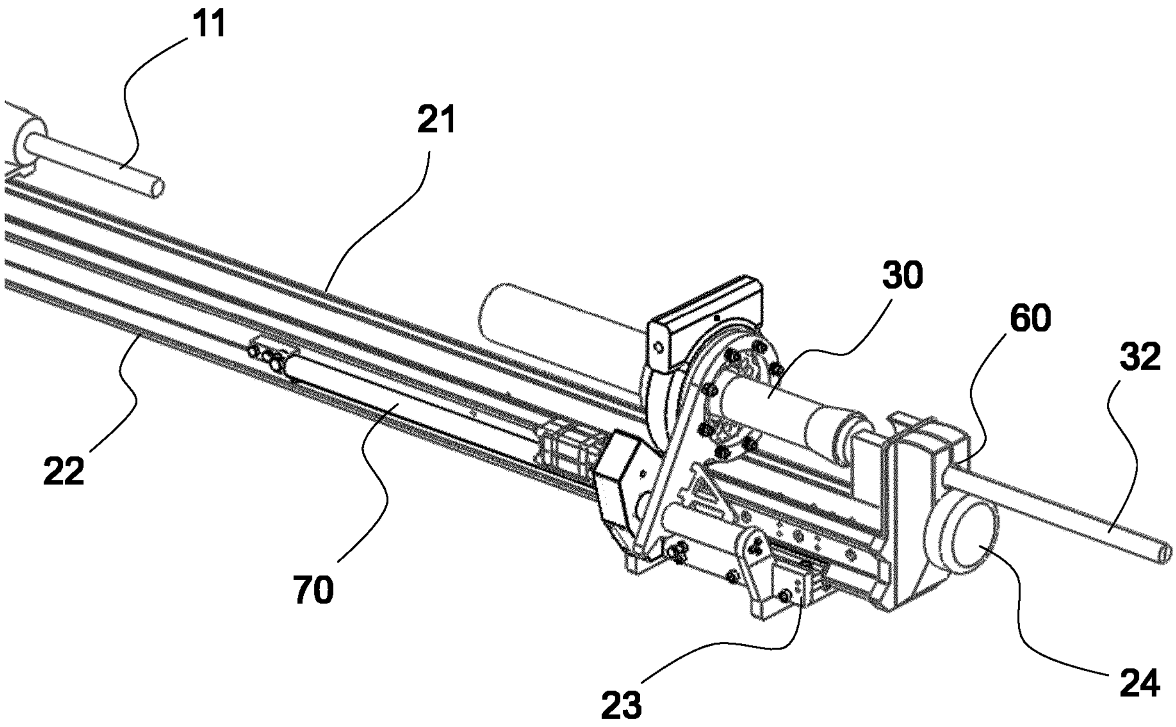

Fig. 7

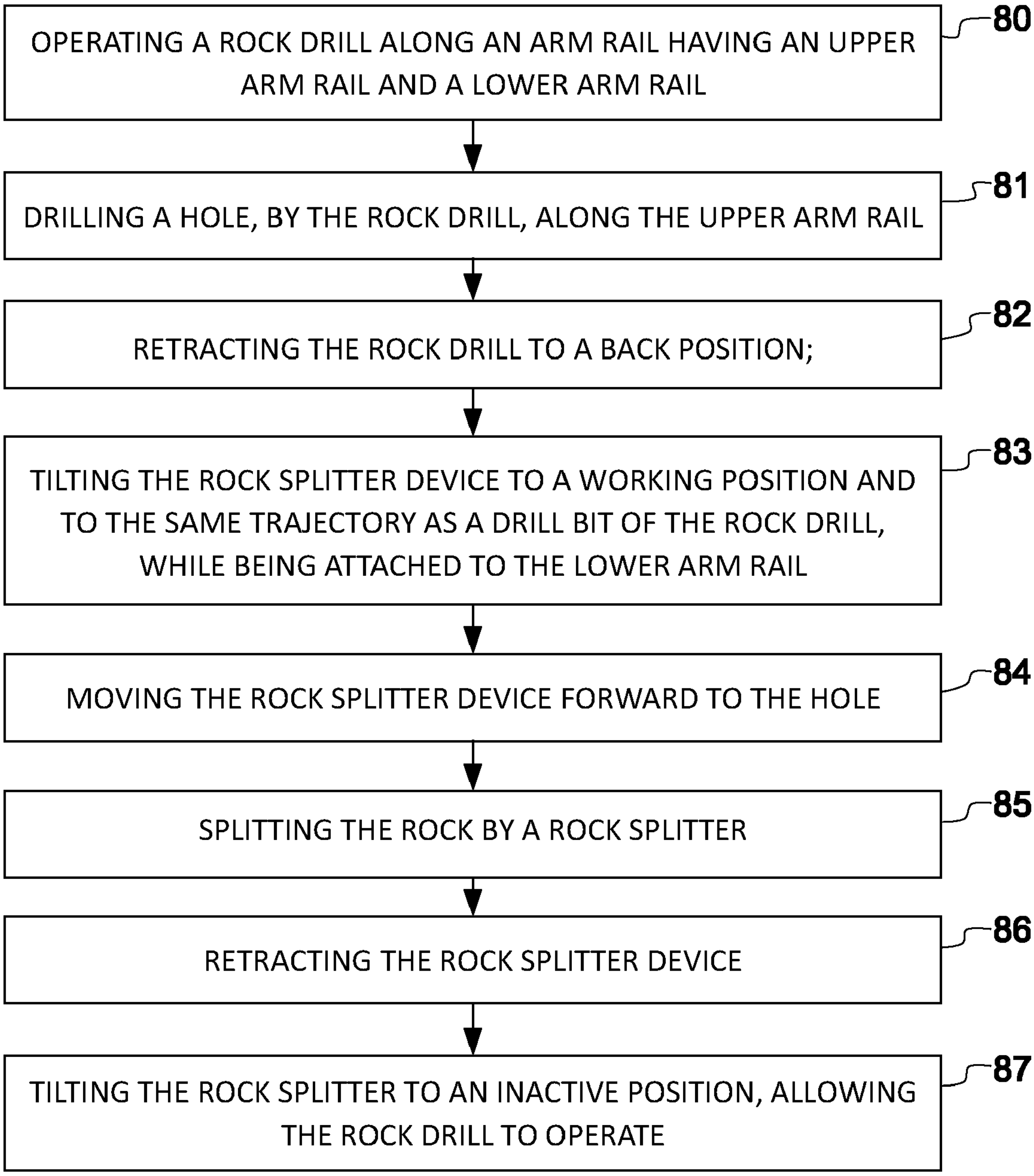
OPERATING A ROCK DRILL ALONG AN ARM RAIL HAVING AN UPPER ARM RAIL AND A LOWER ARM RAIL
80
DRILLING A HOLE, BY THE ROCK DRILL, ALONG THE UPPER ARM RAIL
81
RETRACTING THE ROCK DRILL TO A BACK POSITION;
82
TILTING THE ROCK SPLITTER DEVICE TO A WORKING POSITION AND TO THE SAME TRAJECTORY AS A DRILL BIT OF THE ROCK DRILL, WHILE BEING ATTACHED TO THE LOWER ARM RAIL
83
MOVING THE ROCK SPLITTER DEVICE FORWARD TO THE HOLE
84
SPLITTING THE ROCK BY A ROCK SPLITTER
85
RETRACTING THE ROCK SPLITTER DEVICE
86
TILTING THE ROCK SPLITTER TO AN INACTIVE POSITION, ALLOWING THE ROCK DRILL TO OPERATE
87

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 21 16 6871

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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	17 September 2021	Brassart, P

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