



(51) International Patent Classification:

E21B 19/08 (2006.01)

(21) International Application Number:

PCT/SE2020/050263

(22) International Filing Date:

11 March 2020 (11.03.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1950353-1

21 March 2019 (21.03.2019)

SE

(71) Applicant: EPIROC ROCK DRILLS AKTIEBOLAG

[SE/SE]; 701 91 ÖREBRO (SE).

(72) Inventors: OLSSON, Jan; Yxsta 301, 705 91 ÖREBRO

(SE). EKEFALK, Martin; Kungsleden 3, 692 92 KUMLA

(SE). LARSSON, Björn A.; Furuvägen 6, 152 57 Södertälje (SE).

(74) Agent: EHRNER & DELMAR PATENTBYRÅ AB;

Drottninggatan 33, 111 51 Stockholm (SE).

(81) Designated States (unless otherwise indicated, for every

kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(54) Title: AN APPARATUS, A METHOD AND A DRILLING RIG FOR INSTALLING PIPES IN GROUND

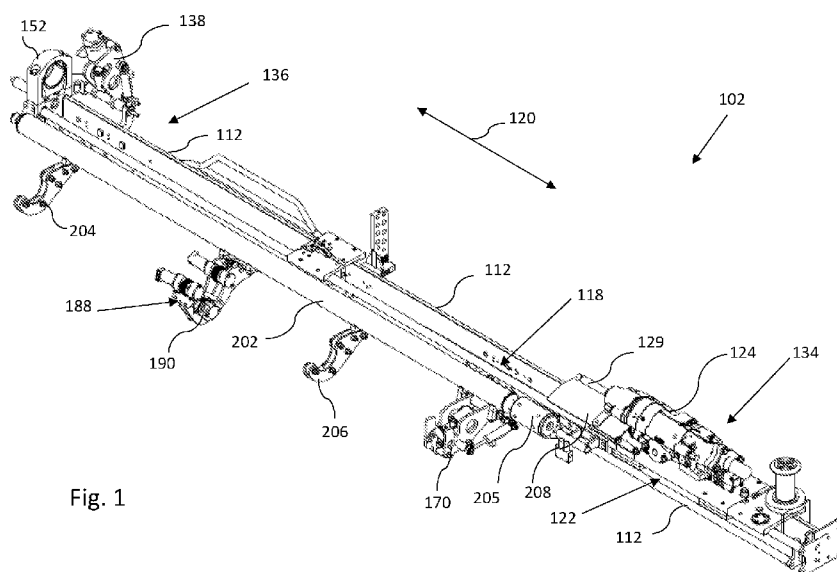


Fig. 1

(57) Abstract: Apparatuses (102) for installing pipes (104, 106) in ground, the apparatus (102) being configured to install pipes (104, 106) connected to a drilling tool (110) and drill the drilling tool (110) into the ground (108) together with the pipes (104, 106). The apparatus (102) comprises a feed beam (112) attachable or connectable to a boom (114) of a drilling rig (116), the feed beam (112) comprising a guide (118) extending in a longitudinal direction (120); a feeder (122), the guide (118) being configured to hold and guide the feeder (122), the feeder (122) being movable in the longitudinal direction (120) in relation to the feed beam (112); a drilling machine (124) attached to the feeder (122) and movable in relation to the feed beam (112), the drilling machine (124) being configured to be attached to the drilling tool (110) by one or more drill rods (126, 128) which in a drilling operation extend inside one or a plurality of the pipes (104, 106) in the longitudinal direction (120); and a first arm (138) attached to the feed beam (112), the first arm (138) having

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

a gripper (140) for gripping and/or holding the drill rod (126, 128), wherein the first arm (138) is movable in relation to the feed beam (112) between an inactive position and an active position, wherein in the active position of the first arm (138) the gripper (140) of the first arm (138) is configured to grip and/or hold the drill rod (126, 128). A drilling rig (116) for installing pipes (104, 106) in ground (108), wherein the drilling rig (116) comprises a boom (114) and such an apparatus (102). Methods associated with such an apparatus (102).

AN APPARATUS, A METHOD AND A DRILLING RIG FOR INSTALLING PIPES IN GROUND

Technical Field

- 5 Aspects of the present invention relate to an apparatus for installing pipes in ground. The apparatus is configured to install pipes connected to a drilling tool and drill the drilling tool into the ground together with the pipes. A drilling machine of the apparatus is configured to be attached to the drilling tool by one or more drill rods which in a drilling operation extend inside one or a plurality of the pipes. Aspects of
- 10 the present invention also relate to a drilling rig for installing pipes in ground, the drilling rig comprising a boom and an apparatus of the above-mentioned sort. Further, aspects of the present invention also relate to methods for installing pipes connected to a drilling tool in ground. The methods comprise the step of drilling the drilling tool into the ground together with the pipes by means of an apparatus of the
- 15 above-mentioned sort.

Background

- When excavating and drilling tunnels or rooms under ground, sometimes there are weak ground conditions. Conventionally, to support and increase the stability of the
- 20 roof and/or walls of a tunnel or a room, a plurality of pipes may be installed in the ground, i.e. in the roof and/or walls. Conventionally, one or more pipes after one another are installed in the same drill hole, and pipes are installed in several drill holes extending side by side, i.e. extending essentially parallel to one another. The structure formed in this way may be called a pipe roof or a pipe wall or a pipe
- 25 umbrella. The concept of installing pipes in this manner may be called pipe roofing. Pipes may be installed in this way to increase stability in portal sections and for the re-excavation of collapsed sections in underground constructions. Another application is ground improvement. Conventionally, a single-use drilling tool is rotatably attached to the first pipe and the drilling tool is drilled into the ground
- 30 together with the pipes. A conventional apparatus used for installing the pipes is attached to a boom of a drilling rig. Conventionally, a drilling machine of the apparatus is attached to the drilling tool by one or more drill rods which in a drilling operation are attached to one another and extend longitudinally inside the pipes. The installation of the pipes as disclosed above involves many steps and is complex.

Summary

An object of embodiments of the invention is to provide a solution which mitigates or solves the drawbacks and problems of conventional solutions.

5

According to a first aspect of the invention, the above-mentioned and other objects of the embodiments of present invention are attained by providing an apparatus for installing pipes in ground. The apparatus is configured to install pipes connected to a drilling tool and drill the drilling tool into the ground together with the pipes. The

10 apparatus comprises

a feed beam attachable or connectable to a boom of a drilling rig, the feed beam comprising a guide extending in a longitudinal direction,

a feeder, the guide being configured to hold and guide the feeder, the feeder being movable in the longitudinal direction in relation to the feed beam,

15 a drilling machine attached to the feeder and movable in relation to the feed beam, the drilling machine being configured to be attached to the drilling tool by one or more drill rods which in a drilling operation extend inside one or a plurality of the pipes in the longitudinal direction, and

20 a first arm attached to the feed beam, the first arm having a gripper for gripping and/or holding the drill rod, wherein the first arm is movable in relation to the feed beam between an inactive position and an active position, wherein in the active position of the first arm the gripper of the first arm is configured to grip and/or hold the drill rod.

25 An advantage of the apparatus according to the first aspect is that by way of the above-mentioned movability of the first arm, when the first arm is the inactive position and thus moved away, room is made for receiving the drill rod and place it in an operating position in which the drill rod is attachable to the drilling machine and to a neighbouring drill rod, and when the first arm is in the active position the
30 drill rod can be manipulated, i.e. gripped or held, by the gripper of the first arm. The installation according to conventional solutions requires several operators, since several steps require manual handling of the pipes and the drill rods by one or more operators. An advantage of the apparatus according to the first aspect is that more steps can be performed solely by the apparatus without any manual handling of the

drill rods by one or more operators. Thus, the installation of the pipes is made more efficient requiring a reduced amount of manual work. The time needed for the installation of the pipes is efficiently reduced. By means of the apparatus according to the first aspect, the installation of pipes in ground or the process of pipe roofing
5 is improved and requires less man hours. Consequently, the stability of roofs and walls having weak ground conditions can be increased in an efficient manner.

The drilling tool may be rotatably attached to a pipe. The drilling tool may comprise an annular drill bit rotatably attached to a pipe at an end thereof and a pilot drill bit
10 fixedly attachable to the annular drill bit. The pilot drill bit is advantageously detachably attached to the annular drill bit. The pilot drill bit is attachable, advantageously detachably attachable, to the drill rods. The annular drill bit is a single-use drill bit and is left in the drill hole. The pilot drill bit may be re-used for consecutive pipe installation. Alternatively, the drilling tool may be a single-use
15 drilling tool rotatably attached to a pipe, and the drill rods may be attached to the single-use drilling tool by an adapter, which may be seen as an interface.

In general, the drill rods are removed from the installed pipes after drilling and re-used for consecutive pipe installation. In general, the drill rods are attachable, for
20 example detachably attachable, to one another and attached to one another during the drilling operation. In general, during the drilling operation the drilling machine is attached to one or more drill rods. The pipes may be attachable to one another.

In the active position of the first arm the gripper of the first arm is configured to grip
25 the drill rod and/or in the active position of the first arm the gripper of the first arm is configured to hold the drill rod. Holding the drill rod may involve supporting, pressing and/or guiding the drill rod. The first arm may be directly or indirectly attached to the feed beam.

30 According to an advantageous embodiment of the apparatus according to the first aspect, in the active position of the first arm the gripper of the first arm is configured to support two of the drill rods in order to align the longitudinal central axes of the two drill rods for aligning the drill rods. An advantage of this embodiment is that the step of attaching two adjacent drill rods to one another is facilitated and can be

performed with less manual work. Thus, the installation of the pipes in ground is further improved.

According to a further advantageous embodiment of the apparatus according to the first aspect, in the active position of the first arm the gripper of the first arm is configured to hold an end portion of a first drill rod of the drill rods and an end portion of a second drill rod of the drill rods to be attached to the first drill rod when the drilling machine is attached to the second drill rod. An advantage of this embodiment is that the step of attaching two adjacent drill rods to one another is facilitated and can be performed with less manual work. Consequently, the installation of the pipes in ground is improved.

According to another advantageous embodiment of the apparatus according to the first aspect, the first arm is pivotably movable in relation to the feed beam between the inactive position and the active position. Thus, the first arm is pivotable between the inactive position and the active position. An advantage of this embodiment is that an efficient movement of the first arm between the inactive and active positions is attained, whereby the installation of a drill rod, for example the attachment of a drill rod to another drill rod and/or to the drilling machine, and the detachment of a drill rod from another drill rod or from the drilling machine are facilitated and can be performed with less manual work. Consequently, the installation of the pipes in ground is improved.

According to still another advantageous embodiment of the apparatus according to the first aspect, the active position of the first arm comprises a first active position and a second active position, wherein the first arm is movable to the first active position and the second active position, wherein in the first active position of the first arm the gripper of the first arm is configured to grip one or two of the drill rods located in a drill centre, and wherein in the second active position of the first arm the gripper of the first arm is configured to interact with a first drill rod of the drill rods and a second drill rod of the drill rods to push the first drill rod against an inner surface edge of a first pipe of the pipes and push the second drill rod against an inner surface edge of a second pipe of the pipes. Thus, in the second active position of the first arm the gripper of the first arm is configured to interact with the first drill rod and the

second drill rod to push the first drill rod against an edge of an inner surface of the first pipe and push the second drill rod against an edge of an inner surface of the second pipe. Advantageously, the second drill rod is attached to the drilling machine when the first arm is in the second active position. Further advantageously, the first
5 drill rod is attached to the drilling tool or another drill rod when the first arm is in the second active position. An advantage of this embodiment is that the attachment of a drill rod to another drill rod or to the drilling machine and the detachment of a drill rod from another drill rod or from the drilling machine are facilitated and can be performed with less manual work. Consequently, the installation of the pipes in
10 ground is improved.

According to yet another advantageous embodiment of the apparatus according to the first aspect, the feeder is movable in the longitudinal direction in relation to the feed beam between a first position and a second position, wherein the first arm is
15 attached, for example directly or indirectly attached, to the feed beam at the second position of the feeder or at the first position of the feeder. An advantage of this embodiment is that the attachment of a drill rod to another drill rod or to the drilling machine and the detachment of a drill rod from another drill rod or from the drilling machine are facilitated and can be performed with less manual work. Consequently,
20 the installation of the pipes in ground is improved.

According to an advantageous embodiment of the apparatus according to the first aspect, the apparatus comprises a muck shield attached, for example directly or indirectly attached, to the feeder and movable in relation to the feed beam, wherein
25 the muck shield is configured to cover a portion of the guide and configured to guide muck away from the guide, whereby muck is prevented from entering the feed beam. An advantage of this embodiment is that muck is efficiently prevented from entering the feed beam, which otherwise could impair the guide and the function and movement of the feeder, or even damage the guide or feeder. By means of this
30 embodiment, the installation of pipes in ground or the process of pipe roofing is improved. Consequently, the stability of roofs and walls having weak ground conditions can be increased in an efficient manner. Muck includes released ground material and slurry leaving the drill hole.

According to a further advantageous embodiment of the apparatus according to the first aspect, when the feeder is movable in the longitudinal direction in relation to the feed beam between a first position and a second position, the muck shield is configured to be positioned between the feeder and the second position of the
5 feeder when the feeder is located anywhere between the first position and the second position. An advantage of this embodiment is that muck is efficiently prevented from entering the feed beam.

According to another advantageous embodiment of the apparatus according to the first aspect, in the active position of the first arm the gripper of the first arm is
10 configured to grip a first drill rod of the drill rods when the feeder is in the second position and when the drilling machine is to be detached from the first drill rod. An advantage of this embodiment is that the detachment of a drill rod from another drill rod is facilitated and can be performed with less manual work. Consequently, the
15 installation of the pipes in ground is improved.

According to yet another advantageous embodiment of the apparatus according to the first aspect, the drill rods are attachable to one another, wherein in the active position of the first arm the gripper of the first arm is configured to grip an end portion
20 of a first drill rod of the drill rods when the feeder is in the first position and when the first drill rod is to be detached from a second drill rod of the drill rods attached to the drilling machine. An advantage of this embodiment is that the detachment of a drill rod from another drill rod is facilitated and can be performed with less manual work. Thus, the process of removing the drill rods from the installed pipes to re-use the
25 drill rods for consecutive pipe installations is facilitated. Consequently, the installation of the pipes in ground is improved.

According to still another advantageous embodiment of the apparatus according to the first aspect, the apparatus comprises a second arm having a gripper for gripping
30 and holding the drill rod, wherein the second arm is movable in relation to the feed beam between an inactive position and an active position, wherein in the active position of the second arm the gripper of the second arm is configured to grip and hold the drill rod, and wherein the second arm is attached, for example directly or indirectly attached, to the feed beam at the first position of the feeder. An advantage

of this embodiment is that the attachment of a drill rod to the drilling machine and the detachment of a drill rod from the drilling machine is facilitated and can be performed with less manual work. Consequently, the installation of the pipes in ground is improved.

5

According to an advantageous embodiment of the apparatus according to the first aspect, the second arm is pivotably movable in relation to the feed beam between the inactive position and the active position. Thus, the second arm is pivotable between the inactive position and the active position. An advantage of this
10 embodiment is that an efficient movement of the second arm between the inactive and active positions is attained, whereby the attachment of a drill rod to the drilling machine and the detachment of a drill rod from the drilling machine are facilitated and can be performed with less manual work. Therefore, the installation of the pipes in ground is improved.

15

According to a further advantageous embodiment of the apparatus according to the first aspect, in the active position of the second arm the gripper of the second arm is configured to grip the drill rod when the feeder is in the first position and when the drilling machine is to be detached from or attached to the drill rod. An advantage of
20 this embodiment is that the attachment of a drill rod to the drilling machine and the detachment of a drill rod from the drilling machine is facilitated and can be performed with less manual work. Consequently, the installation of the pipes in ground is improved.

25 According to another advantageous embodiment of the apparatus according to the first aspect, in the inactive position of the second arm the gripper of the second arm is configured to grip the drill rod before the drill rod is moved from a resting position to an active position between the first position of the feeder and the second position of the feeder, wherein in the active position of the drill rod the drilling machine is
30 attachable to the drill rod. An advantage of this embodiment is that the mounting and attachment of a drill rod to the drilling machine is facilitated and can be performed with less manual work. Consequently, the installation of the pipes in ground is improved.

According to yet another advantageous embodiment of the apparatus according to the first aspect, in the active position of the second arm the gripper of the second arm is configured to grip the drill rod when the drill rod is to be moved away from an active position between the first position of the feeder and the second position of the feeder to a resting position. An advantage of this embodiment is that the detached drill rod can be efficiently removed to be re-used for consecutive pipe installation. Therefore, the installation of the pipes in ground is improved.

According to still another advantageous embodiment of the apparatus according to the first aspect, in the active position of the second arm the gripper of the second arm is configured to grip the drill rod when the drill rod is attached to the drilling machine and when the feed beam is to be lowered to the ground or floor. An advantage of this embodiment is that the apparatus and its drilling machine can be lowered to the ground or floor with a drill rod attached to the drilling machine in a secure and supported manner. Thus, there is no need to detach the last drill rod from drilling machine after the removal of the other drill rods, whereby the collection of the drill rods to be re-used for consecutive pipe installation is facilitated. Therefore, the installation of the pipes in ground is improved.

According to an advantageous embodiment of the apparatus according to the first aspect, the gripper of the first arm is configured to grip and/or hold, the gripper of the second arm is configured to grip and hold and/or the drilling machine is attachable to drill rods which are attachable to one another by means of threads. Threads are an efficient way to attach to the drill rods to one another, whereby the attachment of the drill rods and the detachment of the drill rods to be re-used for consecutive pipe installation are facilitated. Therefore, the installation of the pipes in ground is improved. However, alternative means of attachment for the drill rods are possible, e.g. bayonet mounts.

According to a further advantageous embodiment of the apparatus according to the first aspect, the drilling machine is attachable to a drill rod by means of threads. Threads are an efficient way to attach to the drilling machine to the drill rods, and the drilling machine will also interact efficiently with drill rods attached to one another by means of threads, whereby the attachment of the drilling machine to the drill rods

and the detachment of drill rods from the drilling machine to be re-used for consecutive pipe installation are facilitated. Therefore, the installation of the pipes in ground is improved. However, alternative means of attachment between the drill rod and drilling machine are possible, e.g. bayonet mounts.

5

According to another advantageous embodiment of the apparatus according to the first aspect, the gripper of the first arm and/or the second arm comprises a pair of pincers movable in relation to one another, wherein the pair of pincers is configured to grip the drill rod.

10

According to yet another advantageous embodiment of the apparatus according to the first aspect, the apparatus comprises a pipe feeding device for feeding and moving the pipe in relation to the feed beam, wherein the apparatus comprises a third arm attached, for example directly or indirectly attached, to the feed beam, the pipe feeding device being attached to the third arm, wherein the third arm is movable in relation to the feed beam between an inactive position and an active position, and wherein in the active position of the third arm the pipe feeding device is configured to move a first pipe of the pipes in relation to a second pipe of the pipes to attach the first pipe to the second pipe. An advantage of this embodiment is that by way of the above-mentioned movability of the third arm, the pipe feeding device of the third arm can easily be moved away, i.e. when the third arm is brought to the inactive position, when the handling of the pipe or drill rod so requires. When the pipe is placed in a position to be fed, the third arm can be brought to the active position and the pipe can be fed by the pipe feeding device of the third arm and attached to an adjacent pipe without any manual handling by an operator. A further advantage of this embodiment is that by way of the above-mentioned movability of the third arm, the pipe feeding device can work as a grip to move the pipe from a resting position to a position where the pipe is ready to be fed. Another advantage of this embodiment is that more steps can be performed solely by the apparatus without any manual handling of the pipes by one or more operators. The installation of the pipes is made more efficient requiring a reduced amount of manual work. The time needed for the installation of the pipes is efficiently reduced. By means of this embodiment, the installation of pipes in ground or the process of pipe roofing is

improved and requires less man hours. Consequently, the stability of roofs and walls having weak ground conditions can be increased in an efficient manner.

According to yet another advantageous embodiment of the apparatus according to the first aspect, in the active position of the third arm the pipe feeding device is configured to rotate the pipe about the longitudinal central axis of the pipe in relation to the feed beam. Thus, in the active position of the third arm the pipe feeding device may also be configured to rotate the pipe about the longitudinal central axis of the pipe in relation to an adjacent pipe of the pipes. In the active position of the third arm the pipe feeding device may be configured to move the pipe in the longitudinal direction in relation to the feed beam. Thus, in the active position of the third arm the pipe feeding device may also be configured to move the pipe in the longitudinal direction in relation to an adjacent pipe of the pipes. This is an efficient way to attach pipes to one another, which does not require any manual handling by an operator. Therefore, the installation of the pipes is made more efficient.

According to still another advantageous embodiment of the apparatus according to the first aspect, the pipe feeding device comprises a gripper for gripping and feeding the pipe in the longitudinal direction when the third arm is in the active position, wherein the gripper of the pipe feeding device comprises one or more drive wheels for abutment against the pipe. An advantage of this embodiment is that the pipe can be easily moved from resting position to the operating position where the pipe is ready to be fed. The gripper of pipe feeding device can both efficiently grip the pipe to move the pipe to the operating position where the pipe is ready to be fed and efficiently feed the pipe by means of the drive wheels. By introducing the drive wheels, an efficient feeding of the pipe is provided, whereby the installation of the pipes is made more efficient. Thus, in the inactive position of the third arm, the gripper of the third arm may be configured to grip the pipe when the pipe is in a resting position and move the pipe to the operating position where the pipe is ready to be fed.

According to an advantageous embodiment of the apparatus according to the first aspect, the third arm is attached, for example directly or indirectly attached, to the feed beam between the first position of the feeder and the second position of the

feeder. By this position of the third arm, the pipe feeding device and the gripper of the pipe feeding device can efficiently handle the pipe, whereby the installation of the pipes is made more efficient and requires a reduced amount of manual work.

- 5 According to a further advantageous embodiment of the apparatus according to the first aspect, the gripper of the third arm is configured to be positioned between the gripper of the first arm and the gripper of the second arm when the arms are in the active positions. By this position of the third arm, the pipe feeding device and the gripper of the pipe feeding device can efficiently handle the pipe, whereby the
10 installation of the pipes is made more efficient and requires a reduced amount of manual work.

- According to another advantageous embodiment of the apparatus according to the first aspect, the gripper of the pipe feeding device comprises three drive wheels
15 separated from one another in a circumference direction in relation to a central axis which is substantially parallel to the longitudinal direction. An advantage of this embodiment is that an efficient feeding of the pipe is provided. Thus, the installation of the pipes in ground is improved and requires less man hours. Alternatively, the pipe feeding device may comprise two drive wheels and one idler wheel, or one
20 drive wheel and two idler wheels. Other combinations are also possible

- According to yet another advantageous embodiment of the apparatus according to the first aspect, each drive wheel has an axis of rotation about which the drive wheel is rotatable, wherein the axis of rotation of the drive wheel forms an acute angle with
25 the longitudinal direction. An advantage of this embodiment is that an efficient feeding of the pipe is provided. Thus, the installation of the pipes in ground is improved and requires less man hours.

- According to still another advantageous embodiment of the apparatus according to
30 the first aspect, the third arm is pivotably movable in relation to the feed beam between the inactive position and the active position. Thus, the third arm is pivotable between the inactive position and the active position. An advantage of this embodiment is that an efficient movement of the third arm between the inactive and

active positions is attained, whereby the handling of both drill rods and pipes is facilitated. Consequently, the installation of the pipes in ground is improved.

According to an advantageous embodiment of the apparatus according to the first aspect, the apparatus comprises one or more pipe guiding elements attached, for example directly or indirectly attached, to the feed beam, wherein the pipe guiding element is pivotable in relation to the feed beam between an inactive position and an active position, and wherein in the active position the pipe guiding element is configured to assist the pipe feeding device in guiding the pipe. An advantage of this embodiment is that the movement of the pipe from a resting position to a position where the pipe is ready to be fed is made further efficient, and the guiding of the pipe when fed to be attached to another pipe is further improved. In the inactive position of the pipe guiding element, the pipe guiding element may be configured to assist the gripper of the third arm in moving the pipe from its resting position to the operating position where the pipe is ready to be fed in the longitudinal direction.

According to a further advantageous embodiment of the apparatus according to the first aspect, when the arms and the pipe guiding elements are positioned in the active positions one pipe guiding element is configured to be positioned between the gripper of the first arm and the gripper of the third arm, wherein when the arms and the pipe guiding elements are positioned in the active positions one pipe guiding element is configured to be positioned between the gripper of the second arm and the gripper the third arm. An advantage of this embodiment is that the movement of the pipe from a resting position to a position where the pipe is ready to be fed is made further efficient, and the guiding of the pipe when fed to be attached to another pipe is further improved.

According to another advantageous embodiment of the apparatus according to the first aspect, the apparatus comprises a pivot member extending in the longitudinal direction, the pivot member being pivotable in relation to the feed beam, wherein one or more of the first arm, the second arm, the third arm and the pipe guiding element is/are attached to the pivot member. Thus, the first arm and/or the second arm and/or the third arm and/or the pipe guiding element is/are attached, for example directly or indirectly attached, to the pivot member. An advantage of this

embodiment is that an efficient movement of the arms and the pipe guiding elements between the inactive position and the active position is achieved. Thus, the installation of the pipes is made more efficient.

- 5 According to still another advantageous embodiment of the apparatus according to the first aspect, the pipe feeding device is configured to feed and move a pipe which is attachable to another pipe by means of threads. This is an efficient way to attach pipes to one another, which does require less amount of manual handling by an operator. Therefore, the installation of the pipes is made more efficient.

10

According to an advantageous embodiment of the apparatus according to the first aspect, the pipe feeding device is configured to feed and move a pipe which is attachable to another pipe by means of force fitting. Thus, the pipe feeding device may be configured to force one end of the pipe with a reduced diameter into the end
15 of another pipe, or vice versa.

According to a second aspect of the invention, the above-mentioned and other objects of the embodiments of present invention are attained by providing an apparatus for installing pipes in ground, the apparatus being configured to install
20 pipes connected to a drilling tool and drill the drilling tool into the ground together with the pipes, the apparatus comprising

a feed beam attachable or connectable to a boom of a drilling rig, the feed beam comprising a guide extending in a longitudinal direction,

a feeder, the guide being configured to hold and guide the feeder, the feeder
25 being movable in the longitudinal direction in relation to the feed beam,

a drilling machine attached to the feeder and movable in relation to the feed beam, the drilling machine being configured to be attached to the drilling tool by one or more drill rods which in a drilling operation extend inside one or a plurality of the pipes in the longitudinal direction,

30 a pipe feeding device for feeding and moving the pipe in relation to the feed beam, and

an arm attached, for example directly or indirectly attached, to the feed beam, the pipe feeding device being attached to the arm, wherein the arm is movable in relation to the feed beam between an inactive position and an active

position, and wherein in the active position of the arm the pipe feeding device is configured to move a first pipe of the pipes in relation to a second pipe of the pipes to attach the first pipe to the second pipe.

- 5 An advantage of the apparatus according to the second aspect is that by way of the above-mentioned movability of the arm, the pipe feeding device of the arm can easily be moved away, i.e. the arm is brought to the inactive position, when the handling of the pipe or drill rod so requires. When the pipe is placed in a position to be fed, the arm can be brought to the active position and the pipe can be fed by the
- 10 pipe feeding device of the arm. A further advantage of the apparatus according to the second aspect is that by way of the above-mentioned movability of the arm, the pipe feeding device can work as a grip to move the pipe from a resting position to a position where the pipe is ready to be fed. Another advantage of the apparatus according to the second aspect is that more steps can be performed solely by the
- 15 apparatus without any manual handling of the pipes by one or more operators, or with a reduced amount of manual handling. Thus, the installation of the pipes is made more efficient requiring a reduced amount of manual work. By means of the apparatus according to the second aspect, the installation of pipes in ground or the process of pipe roofing is improved and requires less man hours, and the time
- 20 needed for the installation of the pipes is efficiently reduced. Consequently, the stability of roofs and walls having weak ground conditions can be increased in an efficient manner.

- According to yet another advantageous embodiment of the apparatus according to
- 25 the second aspect, in the active position of the arm the pipe feeding device is configured to rotate the pipe about the longitudinal central axis of the pipe in relation to the feed beam. Thus, in the active position of the arm the pipe feeding device may also be configured to rotate the pipe about the longitudinal central axis of the pipe in relation to an adjacent pipe of the pipes. In the active position of the arm the
- 30 pipe feeding device may be configured to move the pipe in the longitudinal direction in relation to the feed beam. Thus, in the active position of the arm the pipe feeding device may also be configured to move the pipe in the longitudinal direction in relation to an adjacent pipe of the pipes. This is an efficient way to attach pipes to

one another, which does not require any manual handling by an operator. Therefore, the installation of the pipes is made more efficient.

According to another advantageous embodiment of the apparatus according to the
5 second aspect, the pipe feeding device comprises a gripper for gripping and feeding the pipe in the longitudinal direction when the arm is in the active position, wherein the gripper of the pipe feeding device comprises one or more drive wheels for abutment against the pipe. Advantages of this embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of
10 the apparatus according to the first aspect.

According to a further advantageous embodiment of the apparatus according to the second aspect, the gripper of the pipe feeding device comprises three drive wheels separated from one another in a circumference direction in relation to a central axis
15 which is substantially parallel to the longitudinal direction. Advantages of this embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

According to another advantageous embodiment of the apparatus according to the
20 second aspect, each drive wheel has an axis of rotation about which the drive wheel is rotatable, wherein the axis of rotation of the drive wheel forms an acute angle with the longitudinal direction. Advantages of this embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

25 According to yet another advantageous embodiment of the apparatus according to the second aspect, the arm is attached, for example directly or indirectly attached, to the feed beam between the first position of the feeder and the second position of the feeder. Advantages of this embodiment correspond to advantages mentioned
30 above in connection with the corresponding embodiment of the apparatus according to the first aspect.

According to still another advantageous embodiment of the apparatus according to the second aspect, the arm is pivotably movable in relation to the feed beam

between the inactive position and the active position. Thus, the arm is pivotable between the inactive position and the active position. Advantages of this embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

5

According to an advantageous embodiment of the apparatus according to the second aspect, the apparatus comprises one or more pipe guiding elements attached, for example directly or indirectly attached, to the feed beam, wherein the pipe guiding element is pivotable in relation to the feed beam between an inactive position and an active position, and wherein in the active position the pipe guiding element is configured to assist the pipe feeding device in guiding the pipe. In the inactive position of the pipe guiding element, the pipe guiding element may be configured to assist the gripper of the arm in moving the pipe from its resting position to the operating position where the pipe is ready to be fed. Advantages of this embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

According to a further advantageous embodiment of the apparatus according to the second aspect, when the arm and the pipe guiding elements are positioned in the active positions one pipe guiding element is configured to be positioned between the gripper of the arm and the first position of the feeder, wherein when the arm and the pipe guiding elements are positioned in the active positions one pipe guiding element is configured to be positioned between the gripper of the arm and the second position of the feeder and/or between the gripper of the arm and the pipe guide. Advantages of this embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

According to another advantageous embodiment of the apparatus according to the second aspect, the apparatus comprises a pivot member extending in the longitudinal direction, the pivot member being pivotable in relation to the feed beam, wherein one or more of the arm and the pipe guiding element is/are attached to the pivot member. Thus, the arm and/or the pipe guiding element is/are attached, for example directly or indirectly attached, to the pivot member. Advantages of this

embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

According to still another advantageous embodiment of the apparatus according to
5 the second aspect, the pipe feeding device is configured to feed and move a pipe which is attachable to another pipe by means of threads. Advantages of this embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

10 According to yet another advantageous embodiment of the apparatus according to the second aspect, the pipe feeding device is configured to feed and move a pipe which is attachable to another pipe by means of force fitting. Thus, the pipe feeding device may be configured to force one end of a pipe with a reduced diameter into the end of another pipe, or force one end of a pipe with an increased diameter onto
15 the end of another pipe.

According to a third aspect of the invention, the above-mentioned and other objects of the embodiments of present invention are attained by providing an apparatus for installing pipes in ground, the apparatus being configured to install pipes connected
20 to a drilling tool and drill the drilling tool into the ground together with the pipes, the apparatus comprising

a feed beam attachable or connectable to a boom of a drilling rig, the feed beam comprising a guide extending in a longitudinal direction,

a feeder, the guide being configured to hold and guide the feeder, the feeder
25 being movable in the longitudinal direction in relation to the feed beam,

a drilling machine attached to the feeder and movable in relation to the feed beam, the drilling machine being configured to be attached to the drilling tool by one or more drill rods which in a drilling operation extend inside one or a plurality of the pipes in the longitudinal direction, and

30 a muck shield attached, for example directly or indirectly attached, to the feeder and movable in relation to the feed beam, wherein the muck shield is configured to cover a portion of the guide and configured to guide muck away from the guide, whereby muck is prevented from entering the feed beam.

An advantage of the apparatus according to the third aspect is that muck is efficiently prevented from entering the feed beam, which otherwise could impair the guide and the functionality and movement of the feeder, or even damage the guide or feeder. By means of the apparatus according to the third aspect an improved installation of
5 pipes in ground or the process of pipe roofing is provided. Consequently, the stability of roofs and walls having weak ground conditions can be increased in an efficient manner. Muck includes released ground material and slurry leaving the drill hole.

According to an advantageous embodiment of the apparatus according to the third
10 aspect, the feeder is movable in the longitudinal direction in relation to the feed beam between a first position and a second position, wherein the muck shield is configured to be positioned between the feeder and the second position of the feeder when the feeder is located anywhere between the first position and the second position. An advantage of this embodiment is that muck is efficiently prevented from entering the
15 feed beam.

According to a fourth aspect of the invention, the above-mentioned and other objects of the embodiments of present invention are attained by providing a drilling rig for installing pipes in ground, wherein the drilling rig comprises a boom and an
20 apparatus according to any one of the claims 1 to 25, or according to any one of the above-mentioned or below-mentioned embodiments, attached or connected to the boom. Advantages of the drilling rig according to the fourth aspect correspond to advantages mentioned above in connection with the corresponding apparatus according to the first aspect.

25

According to a fifth aspect of the invention, the above-mentioned and other objects of the embodiments of present invention are attained by providing a method for installing pipes connected to a drilling tool in ground, wherein the method comprises drilling the drilling tool into the ground together with the pipes by means of an
30 apparatus comprising

a feed beam attachable to a boom of a drilling rig, the feed beam comprising a guide extending in a longitudinal direction,

a feeder, the guide holding and guiding the feeder, the feeder moving in the longitudinal direction in relation to the feed beam, and

a drilling machine attached to the feeder and movable in relation to the feed beam, wherein

the method comprises attaching the drilling machine to the drilling tool by one or more drill rods which in a drilling operation extend inside one or a plurality of the pipes in the longitudinal direction, wherein the method comprises moving a first arm attached to the feed beam in relation to the feed beam between an inactive position and an active position, and wherein the method comprises gripping and/or holding the drill rod by means of a gripper of the first arm when the first arm is in the active position to assist in the attachment or detachment of a drill rod.

10

Advantages of the method according to the fifth aspect correspond to advantages mentioned in connection with the corresponding apparatus according to the first aspect.

15 According to an advantageous embodiment of the method according to the fifth aspect, the method comprises the step of supporting two drill rods by the gripper of the first arm to align the longitudinal central axes of the drill rods for aligning the drill rods when the first arm is in the active position. Advantages of this embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

20

According to a further advantageous embodiment of the method according to the fifth aspect, method comprises pivotably moving the first arm in relation to the feed beam between the inactive position and the active position. Advantages of this embodiment correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

25

According to another advantageous embodiment of the method according to the fifth aspect, the method comprises moving a second arm attached to the feed beam in relation to the feed beam between an inactive position and an active position, wherein the method comprises gripping and holding the drill rod by means of a gripper of the second arm when the second arm is in the active position to assist in the attachment or detachment of a drill rod. Advantages of this embodiment

30

correspond to advantages mentioned above in connection with the corresponding embodiment of the apparatus according to the first aspect.

- According to a sixth aspect of the invention, the above-mentioned and other objects
- 5 of the embodiments of present invention are attained by providing a method for installing pipes connected to a drilling tool in ground, wherein the method comprises drilling the drilling tool into the ground together with the pipes by means of an apparatus comprising
- 10 a feed beam attachable to a boom of a drilling rig, the feed beam comprising a guide extending in a longitudinal direction,
- a feeder, the guide holding and guiding the feeder, the feeder moving in the longitudinal direction in relation to the feed beam, and
- a drilling machine attached to the feeder and movable in relation to the feed beam, wherein
- 15 the method comprises attaching the drilling machine to the drilling tool by one or more drill rods which in a drilling operation extend inside one or a plurality of the pipes in the longitudinal direction, wherein the method comprises moving an arm attached to the feed beam in relation to the feed beam between an inactive position and an active position, a pipe feeding device being attached to the arm, and wherein
- 20 the method comprises feeding and moving a first pipe in relation to the feed beam and in relation to a second pipe by means of the pipe feeding device when the arm is in the active position to attach the first pipe to the second pipe.

- Advantages of the method according to the six aspect correspond to advantages
- 25 mentioned above in connection with the corresponding apparatus according to the second aspect.

- The apparatus may be configured to install pipes in rock. Then, the drilling machine may be a rock drilling machine. The drilling machine may be a percussive or
- 30 percussion drilling machine. The apparatus may be a top hammer apparatus for top hammer drilling, i.e. the drilling tool is located at one end of a drill string and the drilling machine is located at the other end of the drill string.

The above-mentioned features and embodiments of the apparatus, drilling rig and method, respectively, may be combined in various possible ways providing further advantageous embodiments.

- 5 Further advantageous embodiments of the present invention and further advantages with the embodiments of the present invention emerge from the dependent claims and the detailed description of embodiments.

Brief Description of the Drawings

- 10 Aspects of the present invention will now be described, for exemplary purposes, in more detail by way of embodiments and with reference to the enclosed drawings, in which:
- Fig. 1 is a schematic perspective view illustrating embodiments of the apparatus according to the first aspect, second aspect and/or third aspect;
- 15 Fig. 2 is a schematic perspective view of the apparatus of Fig. 1 but with the feeder and drilling machine in a different position;
- Fig. 3 is a schematic perspective view of a plurality of drill rods and a plurality of pipes separated from one another;
- 20 Fig. 4a is a schematic sectional view of a pipe and a drill rod of Fig. 3 when the drill rod is inserted in the pipe;
- Fig. 4b is a schematic sectional view of a pipe and a drill rod of Fig. 3 when the drill rod is inserted in the pipe;
- Fig. 5 is an enlarged schematic perspective view of a first arm of the apparatus of Figs. 1 and 2 when the first arm is in an inactive position;
- 25 Fig. 6 is a schematic perspective view of the first arm of Fig. 5 with pipes and drill rods positioned essentially in front of the first arm;
- Fig. 7 is a schematic perspective view of the first arm of Figs. 5 and 6 in an active position;
- 30 Fig. 8 is a schematic perspective view of the first arm of Figs. 5 and 6 in another active position;
- Fig. 9 is an enlarged schematic view of a second arm of the apparatus of Figs. 1 and 2 when the second arm is in an inactive position;

- Fig. 10 is a schematic perspective view of the second arm of Fig. 9 in an active position;
- Fig. 11 is a schematic perspective view of the second arm of Fig. 10 in the same active position as in Fig. 10 but from a different perspective;
- 5 Fig. 12 is an enlarged schematic perspective view of a third arm of the apparatus of Figs. 1 and 2;
- Fig. 13 is a schematic perspective view of the third arm of Fig. 12 but from a different perspective;
- Fig. 14 is a schematic perspective view of the apparatus of Figs. 1 and 2 with a pipe and a drill rod in a resting position;
- 10 Fig. 15 is a schematic perspective view of the apparatus of Figs. 1 and 2 with a pipe and a drill rod in an active position;
- Fig. 16 is a schematic side view of a drilling rig to which embodiments of the apparatus according to the first aspect, second aspect and/or third aspect can be mounted;
- 15 Fig. 17 is a flow chart illustrating embodiments of the methods according to the fifths and sixth aspects of the present invention; and
- Fig. 18 is a flow chart illustrating embodiments of the methods according to the fifths and sixth aspects of the present invention.

20

Detailed Description

Figs. 1 and 2 schematically shows aspects of the embodiments of the apparatus 102 according to the first aspect, second aspect and/or third aspect, for installing pipes 104, 106 (see Fig 3) in ground 108 (see Fig. 16) in order to increase stability in the ground 108. Conventionally, the process of installing pipes to increase stability in the ground 108 may be called pipe roofing. With reference to Fig. 3, the apparatus 102 is configured to install pipes 104, 106 mechanically connected to a drilling tool 110 (see Fig. 4a). The apparatus 102 is configured to drill the drilling tool 110 into the ground 108 together with the pipes 104, 106. Each pipe 104, 106 may be made of a metal or a metal alloy, or any other suitable material or a mixture of materials. The apparatus 102 is configured to operate according to a process of drilling drill holes and filling the drill holes with pipes 104, 106. The process includes a series of sequences, one sequence for each drill hole. Each sequence includes a plurality of steps.

With reference to Figs. 1, 2 and 16, the apparatus 102 includes a feed beam 112 attachable or mechanically connectable to a boom 114 of a drilling rig 116. The feed beam 112 has a guide 118 extending in a longitudinal direction 120. The apparatus
5 102 includes a feeder 122. The feeder 122 may be called a carriage. The guide 118 is configured to hold and guide the feeder 122. The feeder 122 is movable in the longitudinal direction 120 in relation to the feed beam 112. The apparatus 102 has a drilling machine 124 attached to the feeder 122 and thus movable in relation to the feed beam 112. The apparatus 102 includes a driving mechanism for driving the
10 feeder 122 along the guide 118. The driving mechanism may be a hydraulic, pneumatic, mechanical and/or electrical driving mechanism, and may for example include a wire configured to pull the feeder 122.

With reference to Figs. 1 and 3, the drilling machine 124 is configured to be attached
15 to the drilling tool 110 by one or more drill rods 126, 128 which in a drilling operation extend inside one or a plurality of the pipes 104, 106 in the longitudinal direction 120. It is to be understood that it is not necessary that the entire drill rod 126, 128 extends inside the pipe 104, 106 but it is enough that at least a portion of the drill rod 126, 128 extends inside the pipe 104, 106 during a drilling operation. This may
20 especially be the case for the drill rod 128 directly attached to the drilling machine 124 during a drilling operation. However, in general, most of the drill rod 126, 128, i.e. a major portion of the drill rod 126, 128, extends inside the pipe 104, 106 during a drilling operation. Portions of the drill rod 126, 128 may extend or may be located in different pipes 104, 106 during the drilling operation. For some drill rods 126, the
25 entire drill rod 126 may extend inside one or more pipes 104, 106 during the drilling operations. The drilling machine 124 has a rotatable attachment shaft 129 attachable to the drill rods 126, 128. Each drill rod 126, 128 may be made of a metal or a metal alloy, or any other suitable material or a mixture of materials.

30 With reference to Figs. 3 and 4a, the drilling tool 110 is rotatably attachable to a first drill rod 126 of the drill rods 126, 128, e.g. by means of bayonet mounts or threads. The other drill rods 128, in this case one second drill rod 128, are detachably attached to the first drill rod 126 and thus indirectly attached to the drilling tool 110. In this embodiment, the drilling tool 110 includes an annular drill bit 130 rotatably

attached to a first pipe 104 of the pipes 104, 106 at an end of the first pipe 104. Further, the drilling tool 110 includes a pilot drill bit 132 fixedly attachable to the annular drill bit 130. Thus, the annular drill bit 130 and the pilot drill bit 132 rotate together in relation to the first pipe 104 when drilling. The annular drill bit 130 and
5 the pilot drill bit 132 together drill the drill hole. The pilot drill bit 132 is advantageously detachably attached to the annular drill bit 130, e.g. by means of threads or bayonet mounts. The pilot drill bit 132 is attachable, advantageously detachably attachable, to the drill rods 126, 128. The annular drill bit 130 is a single-use drill bit and is left in the drill hole after drilling. The pilot drill bit 132 may be re-
10 used for consecutive pipe installation. It is to be understood that other designs of the drilling tool 110 are possible.

In general, the drill rods 126, 128 are removed from the installed pipes 104, 106 after drilling and re-used for consecutive pipe installation. The drill rods 126, 128 are
15 detachably attachable to one another, for example by means of threads, and during the drilling operation the active or operating drill rods 126, 128 are attached to one another. The drilling machine 124 is detachably attachable to a drill rod 126, 128, for example by means of threads or bayonet mounts. With reference to Figs. 4a and 4b, each drill rod 126, 128 has a female thread 133 at one end and a male thread
20 135 at the other end. The rotatable attachment shaft 129 of the drilling machine 124 has a male thread 137 (see Fig. 10). As an alternative, the drill rods 126, 128 could be detachably attachable to one another by means of bayonet mounts.

During the drilling operation the drilling machine 124 is attached to the drill rods 126,
25 128 and may be configured to rotate and strike the drill rods 126, 128. With reference to Figs. 4a and 4b, each drill rod 126, 128 has a longitudinal central axis 156, 158, and the drilling machine 124 is configured to rotate the drill rod 126, 128 about the longitudinal central axis 156, 158 of the drill rod 126, 128. When the drill rod 126, 128 is mechanically connected or attached to the drilling machine 124 the drill rod
30 126, 128 extends in the longitudinal direction 120. When the drill rod 126, 128 is in an operating or drilling position the drill rod 126, 128 is configured to extend at least partly inside the pipe 104, 106 in the longitudinal direction 120, i.e. when the drill rod 126, 128 is in the operating or drilling position at least a part or portion of the drill rod 126, 128 extends inside the pipe 104, 106 in the longitudinal direction 120. In

general, when the drill rod 126, 128 is in an operating or drilling position, most of the drill rod 126, 128 is located inside a pipe 104, 106. The pipes 104, 106 are attachable to one another, which is described in further detailed hereinbelow. The drill rods 126, 128 rotate, push and percuss/strike the drilling tool 110 and thus also
5 pull the pipes 104, 106 into the drill hole when drilling, since the first pipe 104 is attached to the annular drill bit 130 and the other pipes 106 are attached to the first pipe 104. In general, the length of the drill rod 126, 128 exceeds the length of the pipe 104, 106.

10 In Figs. 3, 4a-b, 6, 7, 8, 14 and 15, only two pipes 104, 106 and only two drill rods 126, 128 are shown. However, it is to be understood that more pipes 104, 106 may be installed and that more drill rods 126, 128 may be used for the installation of the pipes 104, 106.

15 With reference to Figs. 1 and 2, the feeder 122 and thus also the drilling machine 124 mounted thereto are movable along the guide 118 in the longitudinal direction 120 in relation to the feed beam 112 between a first position 134 (see Fig. 1) and a second position 136 (see Fig. 2). The first position 134 of the feeder 122 may be a first end position. The second position 136 of the feeder 122 may be a second end
20 position. The first position 134 of the feeder 122 may be a rear or back position. The second position 136 of the feeder 122 may be a front position. When starting drilling, the feeder 122 is positioned at the first position 134 as shown in Fig. 1, and a drill rod and 128 and pipe 106 are received and positioned in an operating or active position between the first and second positions 134, 136 of the feeder 122, for
25 example as shown in Fig. 15. During drilling, the feeder 122 (and the drilling machine 124) is moved from the first position 134 (see Fig. 1) to the second position 136 (see Fig. 2). When drilling, the apparatus 102 is configured such that the second position 136 of the feeder 122 is closer to the drill hole being drilled, or closer to the ground formation being drilled, in relation to the first position 134 of the feeder 122.

30

With reference to Fig. 1 and Fig. 5 to 8, the apparatus 102 includes a first arm 138 attached, for example directly or indirectly attached, to the feed beam 112. In this embodiment, the first arm 138 is pivotally attached to the feed beam 112. Thus, the first arm 138 is pivotable in relation to the feed beam 112. The first arm 138 has a

gripper 140 for gripping and/or holding the drill rod 126, 128. The first arm 138 is movable, in this embodiment pivotably movable, in relation to the feed beam 112 between an inactive position shown in Figs. 1, 2, 5 and 6, and active positions shown in Figs. 7 and 8. Thus, the first arm 138 is pivotable between the inactive position and the active position. With reference to Figs. 7 and 8, in the active position of the first arm 138 the gripper 140 of the first arm 138 is configured to grip and/or hold the drill rod 126, 128. Holding the drill rod 126, 128 by means of the gripper 140 of the first arm 138 may involve supporting, pressing and/or guiding the drill rod 126, 128.

10 With reference to Fig. 5, the first arm 138 is pivotable about a first pivot axis 142 of a first shaft 144. The first shaft 144 is attached to the feed beam 112. The first arm 138 is moved between the inactive position and the active by means of a first hydraulic or pneumatic cylinder 146 of the apparatus 102. The gripper 140 of the first arm 138 has a first grip member 147 and a second grip member 148 movable
15 in relation to one other to grip the drill rod 126, 128 therebetween. The first grip member 147 is movable by means of a drive mechanism 150 of the first arm 138. The gripper 140 of the first arm 138 includes one or more seats 149 or recesses for holding the drill rod 126, 128, for example for pressing, supporting and/or guiding the drill rod 126, 128. The apparatus 102 includes a pipe guide 152 configured to
20 guide a pipe 104, 106 carried by the feed beam 112 at an end of the feed beam 112. The pipe guide 152 may be annular and thus form an opening through which the pipe 104, 106 is guided. In general, when the apparatus 102 is operating and installing pipes 104, 106 in the ground 108, the pipe guide 152 is located between the drilling machine 124 and the drill hole in which the pipes 104, 106 are to be installed, for
25 example located between the second position 136 of the feeder 122 and the drill hole in which the pipes 104, 106 are to be installed.

With reference to Fig. 6, the first pipe 104 has been drilled into the ground 108 by means of the first drill rod 126. The second drill rod 128 is about to be attached to
30 the first drill rod 126. Subsequently, the second pipe 106 will be attached to the first pipe 104, which is disclosed in further detail hereinbelow.

With reference to Figs. 7, in the active position of the first arm 138 the gripper 140 of the first arm 138 is configured to support the first drill rod 126 and the second drill

rod 128, i.e. two drill rods 126, 128, in order to align the longitudinal central axes 156, 158 of the drill rods 126, 128 (see Figs. 4a and 4b) for aligning the drill rods 126, 128, whereupon the drilling machine 124 rotates the second drill rod 128, and the second drill rod 128 is screwed into the first drill rod 126 by means of threads and they are attached. In other words, in the active position of the first arm 138 the gripper 140 of the first arm 138 is configured to hold an end portion 160 of the first drill rod 126 and hold an end portion 162 of the second drill rod 128 to be attached to the first drill rod 126 when the drilling machine 124 is attached to the second drill rod 128. Advantageously, the gripper 140 of the first arm 138 is configured to push the end portion 160 of the first drill rod 126 and push the end portion 162 of the second drill rod 128 when holding the end portions 126, 128.

With reference to Fig. 8, the first arm 138 is in another active position. Firstly, the first drill rod 126 and the pilot drill bit 132 have be detached from the annular drill bit 130 when the feeder 122 has been located at the second position 136. Subsequently, the feeder 122 has been moved to the first position 134 and has pulled out the second drill rod 128 from the second pipe 106. When the feeder 122 is located in the first position 134, the first arm 138 is positioned in this other active position when the drill rods 126, 128 are to be detached from one another and collected to be re-used for consecutive pipe installation. In the active position of the first arm 138 shown in Fig. 8, the gripper 140 of the first arm 138 is configured to grip an end portion 164 of the first drill rod 126 when the feeder 122 is in the first position 134 and when the first drill rod 126 is to be detached from the second drill rod 128 attached to the drilling machine 124. By means of the drilling machine 124 the second drill rod 128 is unscrewed from the first drill rod 126, which is firmly held and gripped by the gripper 140 of the first arm 138. In this manner, the second drill rod 128 is detached from the first drill rod 126.

Additionally, in the active position of the first arm 138 the gripper 140 of the first arm 138 is configured to grip the first drill rod 126 when the feeder 122 and drilling machine 124 are in the second position 136 and when the drilling machine 124 is to be detached from the first drill rod 126. This step will occur during operation when almost the entire first pipe 104 has been drilled and pulled into the drill hole and a second drill rod 128 is to be attached to the first drill rod 126 and a second pipe 106

is to be attached to the first pipe 104. To mount the second drill rod 128 between the first drill rod 126 and the drilling machine 124, the drilling machine 124 should first be detached from the first drill rod 126. Thus, the first drill rod 126 is firmly gripped and held by the gripper 140 of the first arm 138, and the drilling machine 124 is unscrewed from its engagement with the first drill rod 126 by rotation of the attachment shaft 129 of the drilling machine 124, whereupon the feeder 122 and drilling machine 124 are moved to the first position 134. When the feeder 122 and drilling machine 124 are in the first position, the apparatus 102 is ready to receive a second drill rod 128 and a second pipe 106 to be mounted.

10

With reference to Figs. 7 and 8, the active position of the first arm 138 can be described as including a first active position, as shown in Fig. 8, and a second active position, as shown in Fig. 7. The first arm 138 is movable to the first active position and the second active position. With reference to Fig. 8, in the first active position of the first arm 138 the gripper 140 of the first arm 138 is configured to grip one or two of the drill rods 126, 128 located in a drill centre. With reference to Fig. 7, in the second active position of the first arm 138 the gripper 140 of the first arm 138 is configured to interact with the first drill rod 126 and the second drill rod 128 to push the first drill rod 126 against an inner surface edge 166 of the first pipe 104 and push the second drill rod 128 against an inner surface edge 168 of the second pipe 106. With further reference to Fig. 7, in the second active position of the first arm 138 the gripper 140 of the first arm 138 is configured to interact with the first drill rod 126 and the second drill rod 128 to push the first drill rod 126 against an inner surface of the first pipe 104 or an edge 166 of an inner surface of the first pipe 104 and push the second drill rod 128 against an inner surface of the second pipe 106 or an edge 168 of an inner surface of the second pipe 106. Advantageously, this takes place when the second drill rod 128 is attached to the drilling machine 124. Further advantageously, this takes place when the first drill rod 126 is attached to the drilling tool 110 or another drill rod.

30

With reference to Figs. 7 and 8, in the active position of the first arm 138 the gripper 140 of the first arm 138 is configured to be adjacent to the pipe guide 152. In the active position of the first arm 138 the gripper 140 of the first arm 138 is configured to be positioned between the pipe guide 152 and the drilling machine 124 when the

feeder 122 and drilling machine 124 are located anywhere between the first position 134 of the feeder 122 and the second position 136 of the feeder 122. The first arm 138 is attached, for example directly or indirectly attached, to the feed beam 112 at the second position 136 of the feeder 122.

5

With reference to Figs. 1 and Figs. 9 to 11, the apparatus 102 includes a second arm 170 having a gripper 172 for gripping and holding the drill rod 126, 128. The second arm 170 is movable in relation to the feed beam 112 between an inactive position, which is shown in Figs. 1 and 9, and an active position, which is shown in
10 Figs. 10 and 11. In the active position of the second arm 170 the gripper 172 of the second arm 170 is configured to grip and hold the drill rod 126, 128. The second arm 170 is attached, for example directly or indirectly attached, to the feed beam 112 at the first position 134 of the feeder 122. In the shown embodiment, the second arm 170 is pivotably movable in relation to the feed beam 112 between the inactive
15 position and the active position. Thus, the second arm 170 is pivotable between the inactive position and the active position.

With reference to Figs. 1, 2 and 9, the apparatus 102 includes a pivot member 202 extending in the longitudinal direction 120. The pivot member 202 is pivotable about
20 its longitudinal central axis 203 (see Fig. 5) and pivotable in relation to the feed beam 112. The pivot member 202 is pivotably attached to the feed beam 112. The longitudinal central axis 203 of the pivot member 202 may be substantially parallel to the longitudinal direction 120. The apparatus 102 includes a drive mechanism 205, for example a motor, such as an electrical motor, configured to rotate the pivot
25 member 202 about the longitudinal central axis 203 of the pivot member 202.

With reference to Fig. 9, the second arm 170 is attached to the pivot member 202 of the apparatus 102. The second arm 170 is pivotable about a second pivot axis of a second shaft 176. More precisely, in the shown embodiments the second shaft
30 176 is pivotably attached the pivot member 202, and the second arm 170 is thus pivotable in relation to the pivot member 202. Thus, the second arm 170 is pivotable both about the longitudinal central axis 203 (See Fig. 5) of the pivot member 202 and about the second pivot axis of the second shaft 176. For example, the second arm 170 is movable between the inactive position and the active by means of a

second hydraulic or pneumatic cylinder 178 of the apparatus 102. The gripper 172 of the second arm 170 has a first grip member 180 and a second grip member 182 movable in relation to one other to grip the drill rod 126, 128 therebetween. The first grip member 180 of the gripper 172 of the second arm 170 is movable by means of
5 a drive mechanism 184 of the second arm 186.

With reference to Figs. 10 and 11, in the active position of the second arm 170 the gripper 172 of the second arm 170 is configured to grip the drill rod 126, 128 when the feeder 122 is in the first position 134 and when the drilling machine 124 is to be
10 attached to (or detached from) the second drill rod 128 by means of the attachment shaft 129 of the drilling machine 124. Thus, the gripper 172 of the second arm 170 firmly grips the second drill rod 128, and the drilling machine 124 is attached to the second drill rod 128 by rotating the attachment shaft 129 and the male thread 137 of the attachment shaft 129 engages the female thread 133 of the second drill rod
15 128. Fig. 9 shows the second arm 137 in the inactive position after the drilling machine 124 has been attached to the second drill rod 128.

With reference to Fig. 14, an inactive position of the second arm 170 is illustrated. In this inactive position of the second arm 170 the gripper 172 of the second arm
20 170 is configured to grip the drill rod 128 before the drill rod 128 is moved from a resting position, which is shown in Fig. 14, to an active or operating position between the first position 134 of the feeder 122 and the second position 136 of the feeder 122. In this active or operating position of the drill rod 128 the drilling machine 124 is attachable to the drill rod 128.

25

With reference to Fig. 8, in the active position of the second arm 170 the gripper 172 of the second arm 170 is configured to grip the drill rod 128 when the drill rod 128 is to be moved away from an active or operating position between the first position 134 of the feeder 122 and the second position 136 of the feeder 122 to a resting
30 position. Further, in the active position of the second arm 170 the gripper 172 of the second arm 170 is configured to grip the drill rod 126 when the drill rod 126 is attached to the drilling machine 124 and when the feed beam 112 is to be lowered to the ground or floor.

With reference to Figs 1, 2, 12, 13, 14 and 15, the apparatus 102 includes a pipe feeding device 188 for feeding and moving the pipe 104, 106 in relation to the feed beam 112. In this embodiment, the pipes 104, 106 are attachable to one another by means of threads. The apparatus has a third arm 190 attached, for example directly
5 or indirectly attached, to the feed beam 112. The pipe feeding device 188 is attached to the third arm 190. The third arm 190 is movable in relation to the feed beam 112 between an inactive position, which is shown in Fig. 14 (also shown in Figs 1 and 2), and an active position, which is shown in Fig. 15. With reference to Fig. 1, the third arm 190 is attached to the pivot member 202 and thus pivotable together with
10 the pivot member 202. Thus, the third arm 190 is pivotably movable in relation to the feed beam 112 between the inactive position and the active position. Thus, the third arm 190 is pivotable between the inactive position and the active position.

In the active position of the third arm 190 the pipe feeding device 188 is configured
15 to move the second pipe 106 in relation to the first pipe 104 to attach the second pipe 106 to the first pipe 104. In the active position of the third arm 190 the pipe feeding device 188 is configured to rotate the pipe 106 about the longitudinal central axis 158 of the pipe 106 (see Fig. 4b) in relation to the feed beam 112. Thus, in the active position of the third arm 190 the pipe feeding device 188 is configured to
20 rotate the pipe 106 about the longitudinal central axis 158 of the pipe 106 in relation to an adjacent pipe 104, in this case the first pipe 104. In the active position of the third arm 190 the pipe feeding device 188 is also configured to move the pipe 106 in the longitudinal direction 120 in relation to the feed beam 112. Thus, in the active position of the third arm 190 the pipe feeding device 188 is configured to move the
25 pipe 106 in the longitudinal direction 120 in relation to the adjacent pipe 104, i.e. the first pipe 104. This is an efficient way to attach pipes 104, 106 to one another which does not require any manual handling by an operator. Especially, this is an efficient way to attach pipes 104, 106 to another when the pipes 104, 106 are attachable to one other by means of threads. The third arm 190 is attached, for example directly
30 or indirectly attached, to the feed beam 112 between the first position 134 of the feeder 122 and the second position 136 of the feeder 122.

With reference to Figs. 12 and 13, the pipe feeding device 188 includes a gripper 192 for gripping and feeding the pipe 104, 106 when the third arm 190 is in the active

position. The gripper 192 of the pipe feeding device 188 comprises one or more drive wheels 194 for abutment against the pipe 104, 106. The drive wheels 194 are configured to abut against the pipe 104, 106 when the third arm 190 is in the active position. The gripper 192 of the third arm 190 is configured to be positioned between
5 the gripper 140 of the first arm 138 and the gripper 172 of the second arm 170 when the arms 138, 170, 190 are in the active positions. In the inactive position of the third arm 190, the gripper 192 of the third arm 190 is configured to grip the pipe 104, 106 when the pipe 104, 106 is in a resting position and move the pipe 104, 106 to an operating position where the pipe 104, 106 is ready to be fed, i.e. to an operating
10 position between the first position 134 of the feeder 122 and the second position 136 of the feeder 122.

With reference to Fig. 13, the gripper 192 of the pipe feeding device 188 has three drive wheels 194 separated from one another in a circumference direction in relation
15 to a central axis 196 which is substantially parallel to the longitudinal direction 120. Thus, the three drive wheels 194 are spaced apart from one another. Each drive wheel 194 has an axis of rotation 198 about which the drive wheel 194 is rotatable. Each drive wheel 194 is connected to a drive mechanism 199 configured to drive and rotate the wheel 194 about the axis of rotation 198 of the wheel 194. The axis
20 of rotation 198 of the drive wheel 194 forms an acute angle 200 with the longitudinal direction 120 of the guide 118. The acute angle 200 may be between (and including) 1° and 45°, for example between (and including) 2° and 10°. The acute angle 200 may be 2°. When the pipes 104, 106 are attached to one another by means of threads, said acute angle 200 is advantageously adapted to the pitch of the threads
25 of the pipes 104, 106.

Instead of the drive wheels 194 disclosed above, the gripper of the pipe feeding device could be configured to firmly grip the pipe 106, and the pivot member 202 could be movable in the longitudinal direction 120 in relation to the feed beam 112,
30 for example by means of one or more telescopic cylinders, and thus configured to move the pipe 106 in the longitudinal direction 120 in relation to the feed beam 112 to attach the pipe 106 to another pipe 104. For example, the telescopic cylinder may be located and/or attached between the pivot member 202 and the drive mechanism 205, or between the drive mechanism 205 and the feed beam 112. Alternatively,

and instead of the drive wheels 194 disclosed above, the gripper of the pipe feeding device could be configured to firmly grip the pipe 106, and the third arm could be movable in the longitudinal direction 120 in relation to the pivot member 202 and thus configured to move the pipe 106 in the longitudinal direction 120 in relation to the feed beam 112 to attach the pipe 106 to another pipe 104.

With reference to Figs. 1, 14 and 15, the apparatus 102 comprises one or more pipe guiding elements 204, 206 attached, for example directly or indirectly attached, to the feed beam 112. In the shown embodiments, two pipe guiding elements 204, 206 are provided. The pipe guiding element 204, 206 is pivotable in relation to the feed beam 112 between an inactive position, which is shown in Figs. 1 and 14, and an active position, which is shown in Fig. 15. In the active position shown in Fig. 15, the pipe guiding element 204, 206 is configured to assist the pipe feeding device 188 in guiding the pipe 104, 106. In the inactive position of the pipe guiding element 204, 206, the pipe guiding element 204, 206 is configured to assist the gripper 192 of the third arm 190 in moving the pipe 104, 106 from the resting position to the operating position in which the pipe 104, 106 is ready to be fed. When the arms 138, 170, 190 and the pipe guiding elements 204, 206 are positioned in the active positions a first pipe guiding element 204 of the pipe guiding elements 204, 206 is configured to be positioned between the gripper 140 of the first arm 138 and the gripper 192 of the third arm 190. When the arms 138, 170, 190 and the pipe guiding elements 204, 206 are positioned in the active positions a second pipe guiding element 206 of the pipe guiding elements 204, 206 is configured to be positioned between the gripper 172 of the second arm 170 and the gripper 192 of the third arm 190. With reference to Figs. 14 and 15, each pipe guiding element 204, 206 is attached to the pivot member 202, whereby each pipe guiding element 204, 206 is made pivotable.

With reference to Figs. 1, 2 and 9, the apparatus 102 has a muck shield 208 attached, for example directly or indirectly attached, to the feeder 122 and movable in relation to the feed beam 112. The muck shield 208 is configured to cover a portion of the guide 118 and configured to guide muck away from the guide 118, whereby muck is prevented from entering the feed beam 112 which could impair the function of the guide 118 or even damage the guide 118. The muck, i.e. the released ground material and slurry leaving the drill hole, enters the first pipe 104, to which

the drilling tool 110 is rotatably attached, and exits the last pipe 106 having an open end. In the beginning of the drilling when only one pipe 104 is connected to the drilling tool 110, the first pipe 104 and the last pipe 104 are the same pipe 104. The muck shield 208 is configured to be positioned between the feeder 122 and the
5 second position 136 of the feeder 122 when the feeder 122 is located anywhere between the first position 134 and the second position 136. Further, the muck shield 208 is configured to be positioned between the feeder 122 and the pipe guide 152 when the feeder 122 is located anywhere between the first position 134 and the second position 136. With reference to Fig. 9, the apparatus 102 may be configured
10 such that a part or a portion 209 of the muck shield 208 extends or is located between an (open) end portion 211 of the last pipe 106 and the feed beam 112 during drilling operation, whereby muck is efficiently prevented from entering the feed beam 112. With reference to Fig. 2, at least a portion 213 or a part of the muck shield 208 may be made of a flexible material, for example an elastomer material,
15 such as rubber. Advantageously, the portion 209 made of the flexible material faces away from the feeder 122. This is advantageous when the feeder 122 is in the second position 136 and the muck shield 208 may abut against the pipe guide 152. Alternatively, the entire muck shield 208 may be made of said flexible material.

20 With reference to Fig. 16, a drilling rig 116 is schematically illustrated. The drilling rig 116 has a drilling rig body 210 to which wheels 212 are rotatably mounted. The drilling rig 116 is parked close to the ground 108 to be drilled and where the pipes 104, 106 are to be installed. The drilling rig 116 has a boom 114 which is movable in relation to the drilling rig body 210. The feed beam 112 and the apparatus 102
25 are attached, for example directly or indirectly attached, to the boom 114.

The apparatus 102 may be configured to install pipes in rock or a rock formation, i.e. the ground 108 is rock or a rock formation. Then, the drilling machine 124 may be a rock drilling machine. The drilling machine 124 may be a percussive or
30 percussion drilling machine. The apparatus 102 may be a top hammer apparatus for top hammer drilling, i.e. the drilling tool 110 is located at one end of a drill string and the drilling machine 124 is located at the other end of the drill string. The drill string is inter alia formed by the drill rods 126, 128.

- With reference to Fig. 17, a flow chart illustrates embodiments of the methods according to the fifth and sixth aspects of the present invention. The embodiments of the methods provide a method for installing pipes 104, 106 mechanically connected to a drilling tool 110 in ground 108. The embodiments of the method
- 5 comprise drilling the drilling tool 110 into the ground 108 together with the pipes 104, 106 by means of an apparatus 102 including a feed beam 112 attachable to a boom 114 of a drilling rig 116, the feed beam 112 comprising a guide 118 extending in a longitudinal direction 120, a feeder 122, the guide 118 holding and guiding the feeder 122, the feeder 122 moving in the longitudinal direction 120 in relation to the
- 10 feed beam 112, and a drilling machine 124 attached to the feeder 122 and movable in relation to the feed beam 112. In these embodiments of the methods, the drill rods 126, 128 and drilling machine 124 are attached to one another by means of threads, and the pipes 104, 106 are attached to one another by means of threads.
- 15 For installing a subsequent drill rod 128, such as a second drill rod 126, and a subsequent pipe 106, such as a second pipe 106, before further drilling, an embodiment of the methods includes the following steps:
- When the feeder 122 is located at the second position 136 (as shown in Fig. 2), pivotably moving 301 the first arm 138 attached to the feed beam 112 in relation to the feed beam 112 from an inactive position to an active position;
 - Gripping 302 the first drill rod 126 by means of the gripper 140 of the first arm 138 when the first arm 138 is in the active position;
 - Detaching 303 the first drill rod 126 from the drilling machine 124 by rotating the attachment shaft 129 of the drilling machine 124 about its longitudinal central axis by means of the drilling machine 124 while holding the first drill rod 128 in a firm grip by means of the gripper 140 of the first arm 138;
 - Moving 304 the feeder 122 from the second position 136 to the first position 134;
 - Gripping 305 the second drill rod 128 by means of the gripper 172 of the second arm 170 attached to the feed beam 112 before the second drill rod 128 is moved from a resting position (as shown in Fig. 14) to an operating or active position (as shown in Fig. 15) between the first position 134 and the

second position 136, the second drill rod 128 being partly located inside the second pipe 106. This step is illustrated in Fig. 14;

- Gripping 306 the second pipe 106 by means of the gripper 192 of the third arm 190 attached to the feed beam 112 when the third arm 190 is in the inactive position, a pipe feeding device 188 being attached to the third arm 190. This step is illustrated in Fig. 14;
- Pivotably moving 307 the second arm 170 in relation to the feed beam 112 from an inactive position to an active position, and pivotally moving 307 the third arm 190 in relation to the feed beam 112 from the inactive position to the active position, whereby the second drill rod 128 and the second pipe 106 are moved from the resting position (as shown in Fig. 14) to the operating or active position (as shown Fig. 15) between the first position 134 and the second position 136;
- Gripping and holding 308 the second drill rod 128 by means of the gripper 172 of the second arm 170 when the second arm 170 is in the active position. This step is illustrated in Figs. 9 and 10;
- Attaching 309 the second drill rod 128 to the drilling machine 124 by means of threads and by rotating the attachment shaft 129 of the drilling machine 124 about its longitudinal central axis by means of the drilling machine 124, while holding the second drill rod 128 in a firm grip by means of the gripper 172 of the second arm 170;
- Pivotably moving 310 the second arm 170 in relation to the feed beam 112 from the active position (as shown in Figs. 9 and 10) to the inactive position (as shown in Fig. 9);
- Pivotably moving 311 the first arm 138 attached to the feed beam 112 in relation to the feed beam 112 from an inactive position (as shown in Figs. 5 and 6) to an active position (as shown in Fig. 7);
- Holding 312 the two drill rods 126, 128 by means of the gripper 140 of the first arm 138 when the first arm 138 is in the active position, which involves supporting the second drill rod 128 and the adjacent first drill rod 126 by the gripper 140 of the first arm 138 to align the longitudinal central axes 156, 158 (see Figs. 4a and 4b) of the two drill rods 126, 128 for aligning the two drill rods 126, 128 and forcing the first arm 138 to interact with the two drill rods

- 126, 128 to push the first drill rod 126 against the inner surface edge 166 of the first pipe 104 and push the second drill rod 128 against the inner surface edge 168 of the second pipe 106. This step is illustrated in Figs. 7 and 15;
- While holding the two drill rods 126, 128, attaching 313 the second drill rod 128 to the first drill rod 126 by means of threads and by rotating the second drill rod 128 about its the longitudinal central axes 158 by means of the drilling machine 124. This step is illustrated in Fig. 7;
 - Pivotably moving 314 the first arm 138 attached to the feed beam 112 in relation to the feed beam 138 from the active position (as shown in Fig. 7) to the inactive position (as shown in Fig. 5 and 6);
 - Attaching 315 the second pipe 106 to the first pipe 104 by means of threads by feeding the second pipe 106 in relation to the feed beam 112 and in relation to the first pipe 104 by means of the pipe feeding device 188 when the third arm 190 is in the active position;
 - Moving 316 the third arm 190 in relation to the feed beam 112 from the active position to the inactive position (as shown in Figs. 1 and 2); and
 - Drilling 317 a drill hole by means of the drilling tool 110 and pulling the pipes 104, 106 into the drill hole by means of the drilling machine 124, the rotating and striking drill rods 126, 128 and the drilling tool 110, while moving the feeder 122 from the first position 134 to the second position 136.

With reference to Fig. 18, a flow chart illustrates further embodiments of the methods according to the fifth and sixth aspects of the present invention. For detaching a drill rod 128, such as the second drill rod 128, to be re-used for consecutive pipe installation, an embodiment of the methods includes the following steps:

- Detaching 401 the first drill rod 126 and the pilot drill bit 132 from the annular drill bit 130 when the feeder 122 is located at the second position 136 (as illustrated in Fig. 2);
- Moving 402 the feeder 122 and the drilling machine 124 from the second position 136 (as shown in Fig. 2) to the first position 134 (as illustrated in Fig. 8);

- Pivotably moving 403 the first arm 138 from the inactive position (as shown in Figs. 1 and 5) to the active position (as shown in Fig. 8);
- Gripping 404 the first drill rod 126 by means of the gripper 140 of the first arm 138 when the first arm 138 is in the active position. This step is illustrated in Fig. 8;
- Detaching 405 the second drill rod 128 from the first drill rod 126 by rotating the second drill rod 128 about its longitudinal central axis 158 by means of the drilling machine 124 while firmly gripping the first drill rod 126 by means of the gripper 140 of the first arm 138. This step is illustrated in Fig. 8;
- Pivotably moving 406 the second arm 170 from the inactive position (as shown in Fig. 1) to the active position, and pivotally moving the third arm 190 from the inactive position (as shown in Fig. 1) to the active position;
- Gripping 407 the second drill rod 128 by means of the gripper 172 of the second arm 170 when the second arm 170 is in the active position;
- Detaching 408 the second drill rod 128 from the drilling machine 124 by rotating the attachment shaft 129 of the drilling machine 124 about its longitudinal central axis by means of the drilling machine 124 while holding the second drill rod 128 in a firm grip by means of the gripper 172 of the second arm 170;
- Pivotably moving 409 the second arm 170 from the active position to the inactive position, and pivotally moving 416 the third arm 190 from the active position and the inactive position, the third arm 190 assisting in the support of the drill rod 128 during this movement, whereby the second drill rod 128 is moved from its operating or active position to the resting position for subsequent collection; and
- Moving 410 the feeder 122 and the drilling machine 124 from the first position 134 to the second position to collect the next drill rod 126.

When the pipes 104, 106 have been installed in the ground 108, the pipes 104, 106 may be filled with cement or any other suitable material.

It is to be understood that one or more additional steps may be added and performed, and some of the above-mentioned steps may be repeated when

mounting and attaching additional drill rods and additional pipes and when detaching additional rods. One or more of the above-mentioned steps may be excluded. When detaching the drill rods 124, 126 for consecutive pipe installation, the last drill rod 126 may stay attached to the drilling machine 124.

5

In some embodiments of the apparatus 102 according to the present invention, the second arm 170, the third arm 190, the pipe guiding elements 204, 206 and the muck shield 208 may be excluded, letting the first arm 138 remain. In some other embodiments, the first arm 138, the third arm 190, the pipe guiding elements 204, 206 and the muck shield 208 may be excluded, letting the second arm 170 remain. In some further embodiments, the first arm 138, the second arm 170, the pipe guiding elements 204, 206 and the muck shield 208 may be excluded, letting the third arm 190 remain. In some other embodiments, the first, second and third arms 138, 170, 190 and the pipe guiding elements 204, 206 may be excluded, letting the muck shield 208 remain.

10
15

The drill rods 126, 128 may be hollow to feed a liquid, for example water, via the drilling machine 124 and the hollow drill rods 126, 128 to the drilling tool 110. However, other liquid feeding solutions are possible.

20

The invention shall not be considered limited to the embodiments illustrated, but can be modified and altered in many ways by one skilled in the art, without departing from the scope of the appended claims.

25

CLAIMS

1. An apparatus (102) for installing pipes (104, 106) in ground (108), the apparatus (102) being configured to install pipes (104, 106) connected to a drilling tool (110) and drill the drilling tool (110) into the ground (108) together with the pipes (104, 106), the apparatus (102) comprising
 - a feed beam (112) attachable or connectable to a boom (114) of a drilling rig (116), the feed beam (112) comprising a guide (118) extending in a longitudinal direction (120),
 - 10 a feeder (122), the guide (118) being configured to hold and guide the feeder (122), the feeder (122) being movable in the longitudinal direction (120) in relation to the feed beam (112),
 - a drilling machine (124) attached to the feeder (122) and movable in relation to the feed beam (112), the drilling machine (124) being configured to be attached
 - 15 to the drilling tool (110) by one or more drill rods (126, 128) which in a drilling operation extend inside one or a plurality of the pipes (104, 106) in the longitudinal direction (120), and
 - a first arm (138) attached to the feed beam (112), the first arm (138) having a gripper (140) for gripping and/or holding the drill rod (126, 128), wherein the first
 - 20 arm (138) is movable in relation to the feed beam (112) between an inactive position and an active position, wherein in the active position of the first arm (138) the gripper (140) of the first arm (138) is configured to grip and/or hold the drill rod (126, 128).
2. An apparatus (102) according to claim 1, wherein in the active position of
- 25 the first arm (138) the gripper (140) of the first arm (138) is configured to support two of the drill rods (126, 128) in order to align the longitudinal central axes (156, 158) of the two drill rods (126, 128) for aligning the drill rods (126, 128).
3. An apparatus (102) according to claim 1 or 2, wherein the first arm (138) is
- 30 pivotably movable in relation to the feed beam (112) between the inactive position and the active position.
4. An apparatus (102) according to any one of the claims 1 to 3, wherein the active position of the first arm (138) comprises a first active position and a second

active position, wherein the first arm (138) is movable to the first active position and the second active position, wherein in the first active position of the first arm (138) the gripper (140) of the first arm (138) is configured to grip one or two of the drill rods (126, 128) located in a drill centre, and wherein in the second active position
5 of the first arm (138) the gripper (140) of the first arm (138) is configured to interact with a first drill rod (126) of the drill rods (126, 128) and a second drill rod (128) of the drill rods (126, 128) to push the first drill rod (126) against an inner surface edge (166) of a first pipe (104) of the pipes (104, 106) and push the second drill rod (128) against an inner surface edge (168) of a second pipe (106) of the pipes (104, 106).

10

5. An apparatus (102) according to any one of the claims 1 to 4, wherein the apparatus (102) comprises a muck shield (208) attached to the feeder (122) and movable in relation to the feed beam (112), and wherein the muck shield (208) is configured to cover a portion of the guide (118) and configured to guide muck away
15 from the guide (118), whereby muck is prevented from entering the feed beam (112).

6. An apparatus (102) according to any one of the claims 1 to 5, wherein the feeder (122) is movable in the longitudinal direction (120) in relation to the feed beam (112) between a first position (134) and a second position (136), and wherein
20 the first arm (138) is attached to the feed beam (112) at the second position (136) of the feeder (122) or at the first position (134) of the feeder (122).

7. An apparatus (102) according to claim 6, wherein in the active position of the first arm (138) the gripper (140) of the first arm (138) is configured to grip a first
25 drill rod (126) of the drill rods (126, 128) when the feeder (122) is in the second position (136) and when the drilling machine (124) is to be detached from the first drill rod (126).

8. An apparatus (102) according to claim 6 or 7, wherein the drill rods (126, 128) are attachable to one another, wherein in the active position of the first arm (138) the gripper (140) of the first arm (138) is configured to grip an end portion (164) of a first drill rod (126) of the drill rods (126, 128) when the feeder (122) is in the first position (134) and when the first drill rod (126) is to be detached from a second drill rod (126) of the drill rods (126, 128) attached to the drilling machine (124).
30

9. An apparatus (102) according to any one of the claims 1 to 8, wherein the apparatus (102) comprises a second arm (170) having a gripper (172) for gripping and holding the drill rod (126, 128), wherein the second arm (170) is movable in relation to the feed beam (112) between an inactive position and an active position, wherein in the active position of the second arm (170) the gripper (172) of the second arm (170) is configured to grip and hold the drill rod (126, 128), and wherein the second arm (170) is attached to the feed beam (112) at the first position (134) of the feeder (122).
10. An apparatus (102) according to claim 9, wherein the second arm (170) is pivotably movable in relation to the feed beam (112) between the inactive position and the active position.
11. An apparatus (102) according to claim 9 or 10, wherein in the active position of the second arm (170) the gripper (172) of the second arm (170) is configured to grip the drill rod (126, 128) when the feeder (122) is in the first position (134) and when the drilling machine (124) is to be detached from or attached to the drill rod (126, 128).
12. An apparatus (102) according to any one of the claims 1 to 11, wherein the gripper (140) of the first arm (138) is configured to grip and/or hold, the gripper (172) of the second arm (170) is configured to grip and hold and/or the drilling machine (124) is attachable to drill rods (126, 128) which are attachable to one another by means of threads (133, 135).
13. An apparatus (102) according to any one of the claims 1 to 12, wherein the drilling machine (124) is attachable to a drill rod (126, 128) by means of threads (133, 135, 137).
14. An apparatus (102) according to any one of the claims 1 to 13, wherein the apparatus comprises a pipe feeding device (188) for feeding and moving the pipe (104, 106) in relation to the feed beam (112), wherein the apparatus (102) comprises a third arm (190) attached to the feed beam (112), the pipe feeding device (188)

being attached to the third arm (190), wherein the third arm (190) is movable in relation to the feed beam (112) between an inactive position and an active position, and wherein in the active position of the third arm (190) the pipe feeding device (188) is configured to move a first pipe (104, 106) of the pipes (104, 106) in relation
5 to a second pipe (104, 106) of the pipes (104, 106) to attach the first pipe (104, 106) to the second pipe (104, 106).

15. An apparatus (102) according to claim 14, wherein the pipe feeding device (188) comprises a gripper (192) for gripping and feeding the pipe (104, 106) when
10 the third arm (190) is in the active position, and wherein the gripper (192) of the pipe feeding device (188) comprises one or more drive wheels (194) for abutment against the pipe (104, 106).

16. An apparatus (102) according to claim 15, wherein the gripper (192) of the
15 pipe feeding device (188) comprises three drive wheels (194) separated from one another in a circumference direction in relation to a central axis (196) which is substantially parallel to the longitudinal direction (120).

17. An apparatus (102) according to claim 15 or 16, wherein each drive wheel
20 (194) has an axis of rotation (198) about which the drive wheel (194) is rotatable, and wherein the axis of rotation (198) of the drive wheel (194) forms an acute angle (200) with the longitudinal direction (120).

18. An apparatus (102) according to any one of the claims 14 to 17, wherein the
25 third arm (190) is pivotably movable in relation to the feed beam (112) between the inactive position and the active position.

19. An apparatus (102) according to any one of the claims 14 to 18, wherein the
apparatus (102) comprises one or more pipe guiding elements (204, 206) attached
30 to the feed beam (112), wherein the pipe guiding element (204, 206) is pivotable in relation to the feed beam (112) between an inactive position and an active position, and wherein in the active position the pipe guiding element (204, 206) is configured to assist the pipe feeding device (188) in guiding the pipe (104, 106).

20. An apparatus (102) according to any one of the claims 14 to 19, wherein the pipe feeding device (188) is configured to feed and move a pipe (104, 106) which is attachable to another pipe (104, 106) by means of threads.

5 21 An apparatus according to any one of the claims 1 to 20, wherein the apparatus (102) comprises a pivot member (202) extending in the longitudinal direction (120), the pivot member (202) being pivotable in relation to the feed beam (112), and wherein one or more of the first arm (138), the second arm (170), the third arm (190) and the pipe guiding element (204, 206) is/are attached to the pivot
10 member (202).

22. An apparatus (102) for installing pipes (104, 106) in ground, the apparatus (102) being configured to install pipes (104, 106) connected to a drilling tool (110) and drill the drilling tool (110) into the ground (108) together with the pipes (104,
15 106), the apparatus (102) comprising

a feed beam (112) attachable or connectable to a boom (114) of a drilling rig (116), the feed beam (112) comprising a guide (118) extending in a longitudinal direction (120),

a feeder (122), the guide (118) being configured to hold and guide the feeder (122), the feeder (122) being movable in the longitudinal direction (120) in relation
20 to the feed beam (112),

a drilling machine (124) attached to the feeder (122) and movable in relation to the feed beam (112), the drilling machine (124) being configured to be attached to the drilling tool (110) by one or more drill rods (126, 128) which in a drilling
25 operation extend inside one or a plurality of the pipes (104, 106) in the longitudinal direction (120),

a pipe feeding device (188) for feeding and moving the pipe (104, 106) in relation to the feed beam (112), and

an arm (190) attached to the feed beam (112), the pipe feeding device (188)
30 being attached to the arm (190), wherein the arm (190) is movable in relation to the feed beam (112) between an inactive position and an active position, and wherein in the active position of the arm (190) the pipe feeding device (188) is configured to move a first pipe (104, 106) of the pipes (104, 106) in relation to a second pipe (104,

106) of the pipes (104, 106) to attach the first pipe (104, 106) to the second pipe (104, 106).

23. An apparatus (102) according to claim 22, wherein the pipe feeding device
5 (188) comprises a gripper (192) for gripping and feeding the pipe (104, 106) when the arm (190) is in the active position, and wherein the gripper (192) of the pipe feeding device (188) comprises one or more drive wheels (194) for abutment against the pipe (104, 106).

10 24. An apparatus (102) according to claim 23, wherein the gripper (192) of the pipe feeding device (188) comprises three drive wheels (194) separated from one another in a circumference direction in relation to a central axis (196) which is substantially parallel to the longitudinal direction (120).

15 25. An apparatus (102) for installing pipes (104, 106) in ground (108), the apparatus (102) being configured to install pipes (104, 106) connected to a drilling tool (110) and drill the drilling tool (110) into the ground together with the pipes (104, 106), the apparatus (102) comprising

a feed beam (112) attachable or connectable to a boom (114) of a drilling
20 rig (116), the feed beam (112) comprising a guide (118) extending in a longitudinal direction (120),

a feeder (122), the guide (118) being configured to hold and guide the feeder (122), the feeder (122) being movable in the longitudinal direction (120) in relation to the feed beam (112),

25 a drilling machine (124) attached to the feeder (122) and movable in relation to the feed beam (112), the drilling machine (124) being configured to be attached to the drilling tool (110) by one or more drill rods (126, 128) which in a drilling operation extend inside one or a plurality of the pipes (104, 106) in the longitudinal direction (120), and

30 a muck shield (208) attached to the feeder (122) and movable in relation to the feed beam (112), wherein the muck shield (208) is configured to cover a portion of the guide (118) and configured to guide muck away from the guide (118), whereby muck is prevented from entering the feed beam (112).

26. A drilling rig (116) for installing pipes (104, 106) in ground (108), wherein the drilling rig (116) comprises a boom (114) and an apparatus (102) according to any one of the claims 1 to 25 attached or connected to the boom (114).

5 27. A method for installing pipes (104, 106) connected to a drilling tool (110) in ground (108), wherein the method comprises drilling (317) the drilling tool (110) into the ground together with the pipes (104, 106) by means of an apparatus (102) comprising

10 a feed beam (112) attachable to a boom (114) of a drilling rig (116), the feed beam (112) comprising a guide (118) extending in a longitudinal direction (120),

a feeder (122), the guide (118) holding and guiding the feeder (122), the feeder (122) moving in the longitudinal direction (120) in relation to the feed beam (112), and

15 a drilling machine (124) attached to the feeder (122) and movable in relation to the feed beam (112), wherein

the method comprises attaching (309) the drilling machine (124) to the drilling tool (110) by one or more drill rods (126, 128) which in a drilling operation extend inside one or a plurality of the pipes (104, 106) in the longitudinal direction (120), wherein the method comprises moving (311) a first arm (138) attached to the feed beam (112) in relation to the feed beam (112) between an inactive position and an active position, and wherein the method comprises gripping and/or holding (312) the drill rod (126, 128) by means of a gripper (140) of the first arm (138) when the first arm (138) is in the active position to assist in the attachment or detachment of a drill rod (126, 128).

25

28. A method according to claim 27, wherein the method comprises the step of supporting (312) two drill rods (126, 128) by the gripper (140) of the first arm (138) to align the longitudinal central axes (156, 158) of the drill rods (126, 128) for aligning the drill rods (126, 128) when the first arm (138) is in the active position.

30

29. A method according to claim 27 or 28, wherein the method comprises pivotably moving (311) the first arm (138) in relation to the feed beam (112) between the inactive position and the active position.

30. A method according to any one of the claims 27 to 29, wherein the method comprises moving (307) a second arm (170) attached to the feed beam (112) in relation to the feed beam (112) between an inactive position and an active position, and wherein the method comprises gripping and holding (308) the drill rod (126,
5 128) by means of a gripper (172) of the second arm (172) when the second arm (170) is in the active position to assist in the attachment or detachment of a drill rod (126, 128).

31. A method for installing pipes (104, 106) connected to a drilling tool (110) in
10 ground (108), wherein the method comprises drilling (317) the drilling tool (110) into the ground (108) together with the pipes (104, 106) by means of an apparatus (102) comprising

a feed beam (112) attachable to a boom (114) of a drilling rig (116), the feed beam (112) comprising a guide (118) extending in a longitudinal direction (120),
15 a feeder (122), the guide (118) holding and guiding the feeder (122), the feeder (122) moving in the longitudinal direction (120) in relation to the feed beam (112), and

a drilling machine (124) attached to the feeder (122) and movable in relation to the feed beam (112), wherein
20 the method comprises attaching (309) the drilling machine (124) to the drilling tool (110) by one or more drill rods (126, 128) which in a drilling operation extend inside one or a plurality of the pipes (104, 106) in the longitudinal direction (120), wherein the method comprises moving (307) an arm (190) attached to the feed beam (112) in relation to the feed beam (112) between an inactive position and
25 an active position, a pipe feeding device (188) being attached to the arm (190), and wherein the method comprises feeding and moving (315) a first pipe (104, 106) of the pipes (104, 106) in relation to the feed beam (112) and in relation to a second pipe (104, 106) of the pipes (104, 106) by means of the pipe feeding device (188) when the arm (190) is in the active position to attach the first and second pipes (104,
30 106) to one another.

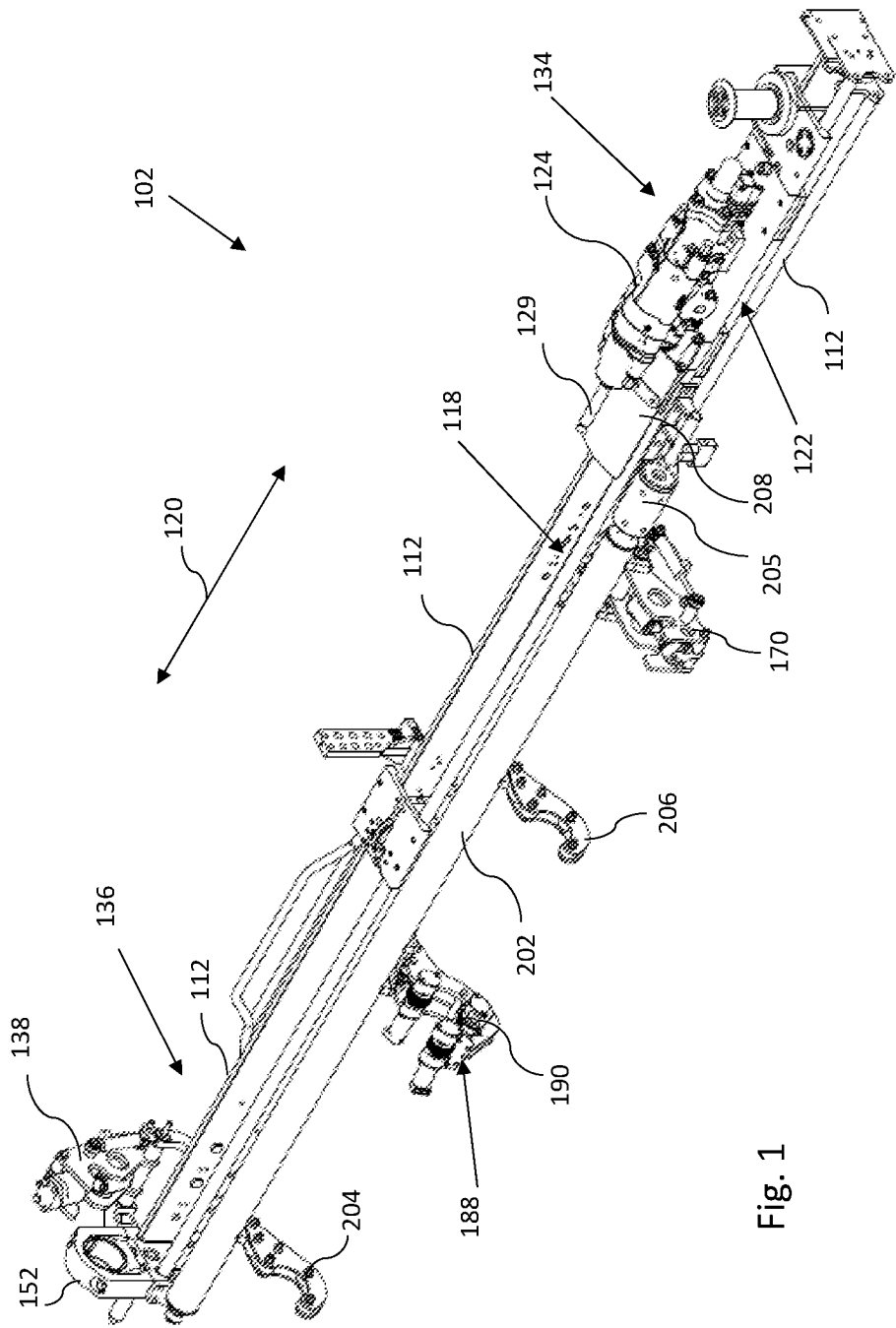


Fig. 1

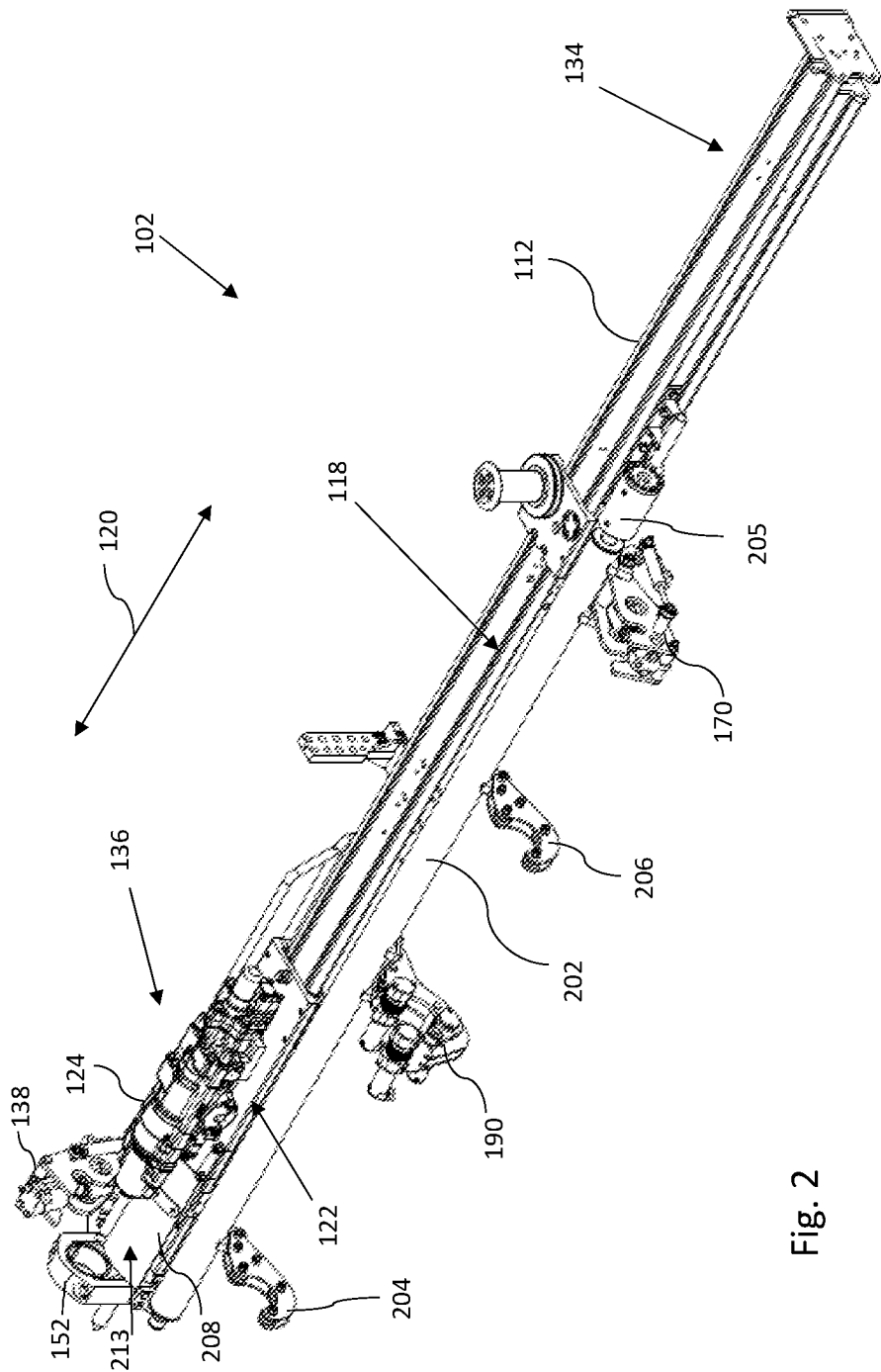


Fig. 2

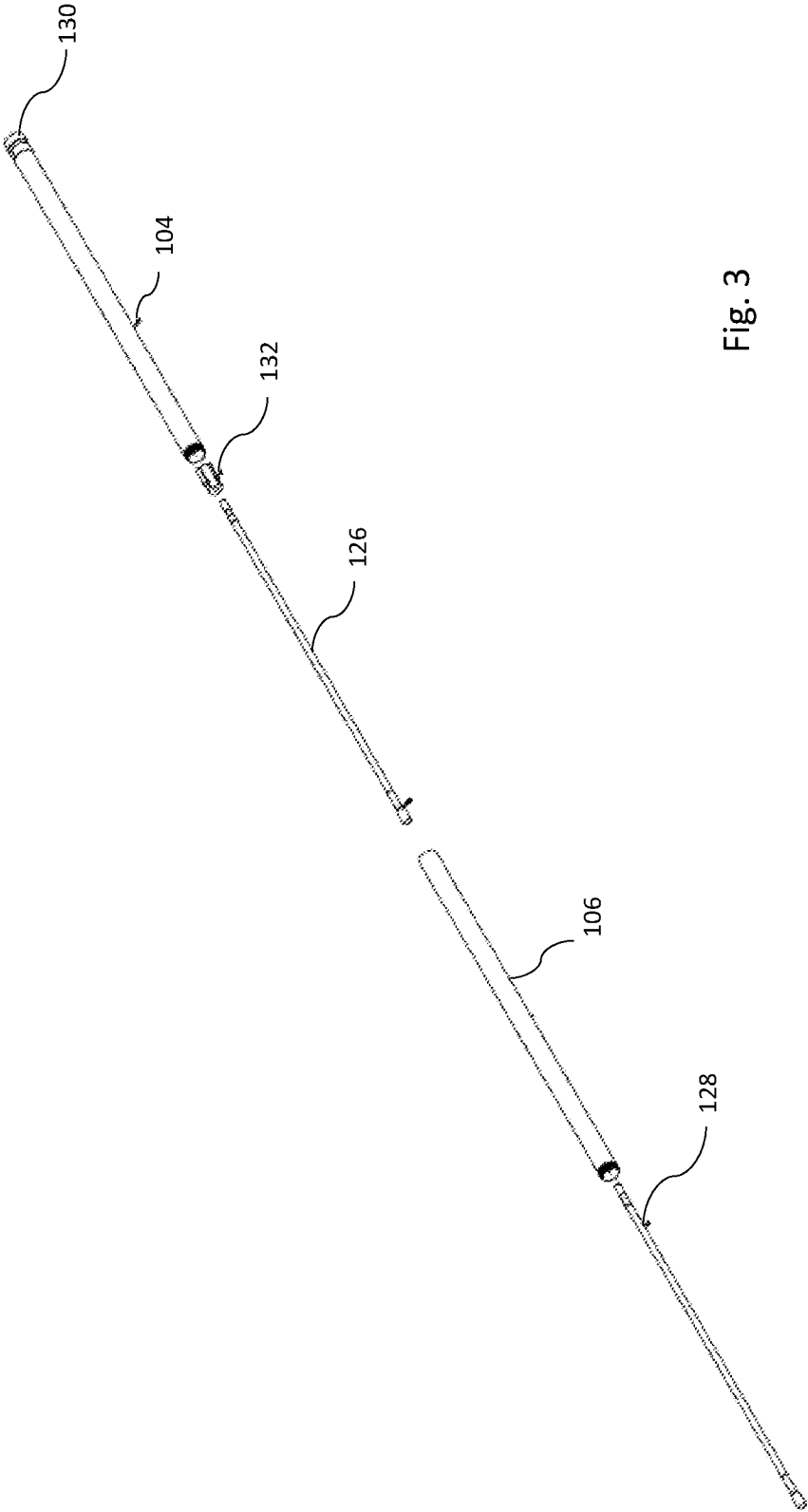
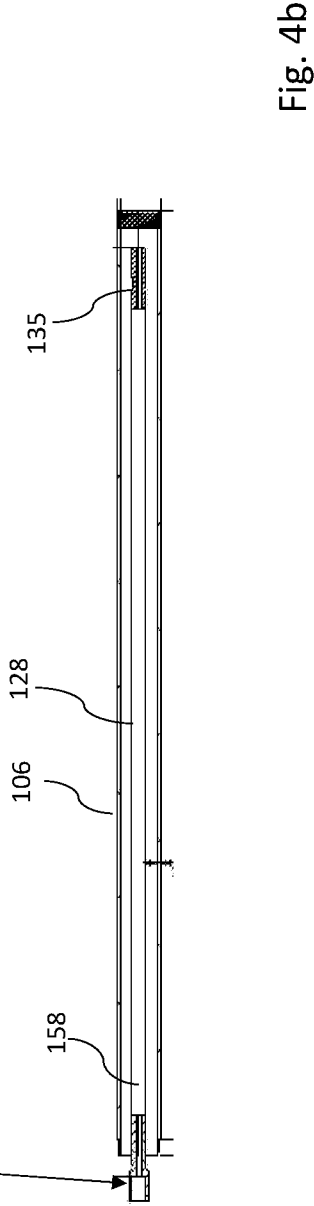
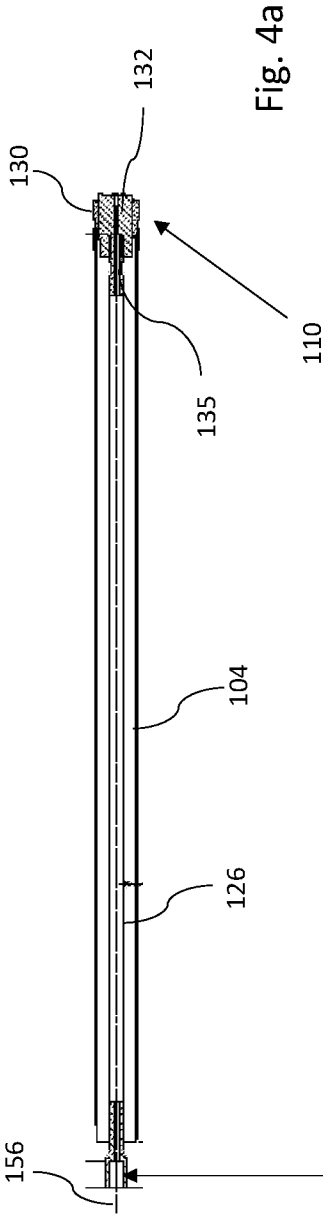


Fig. 3



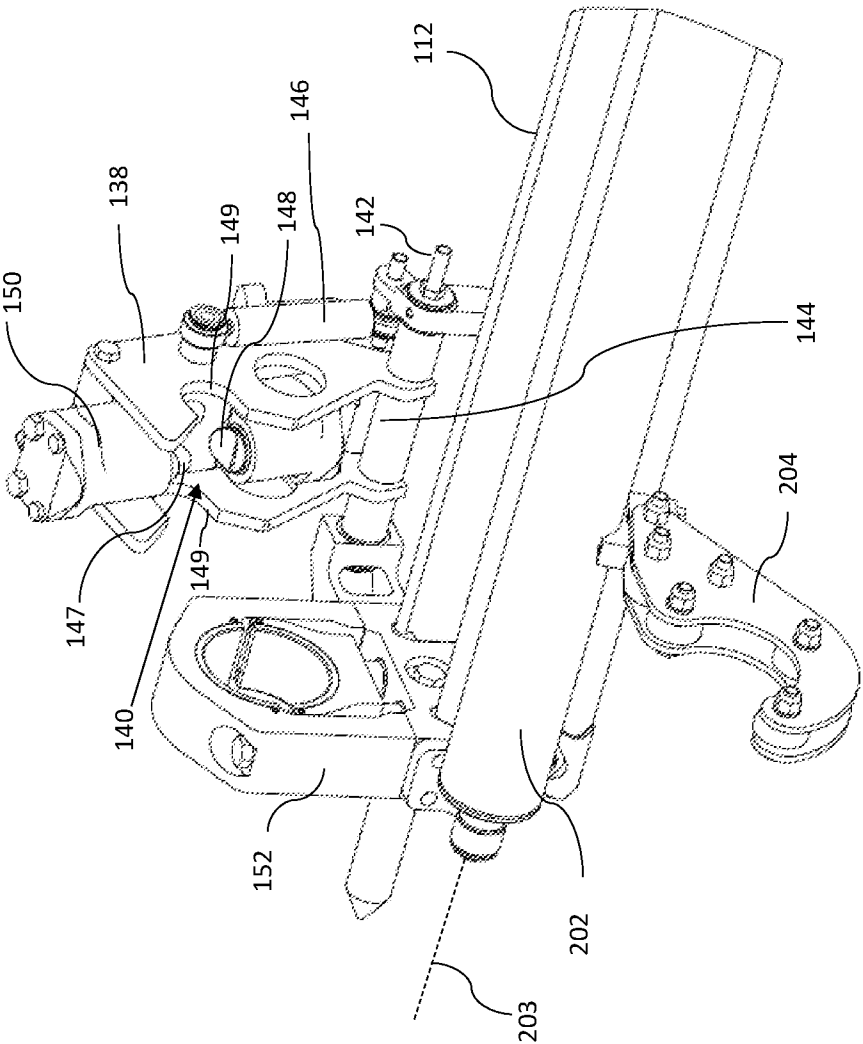
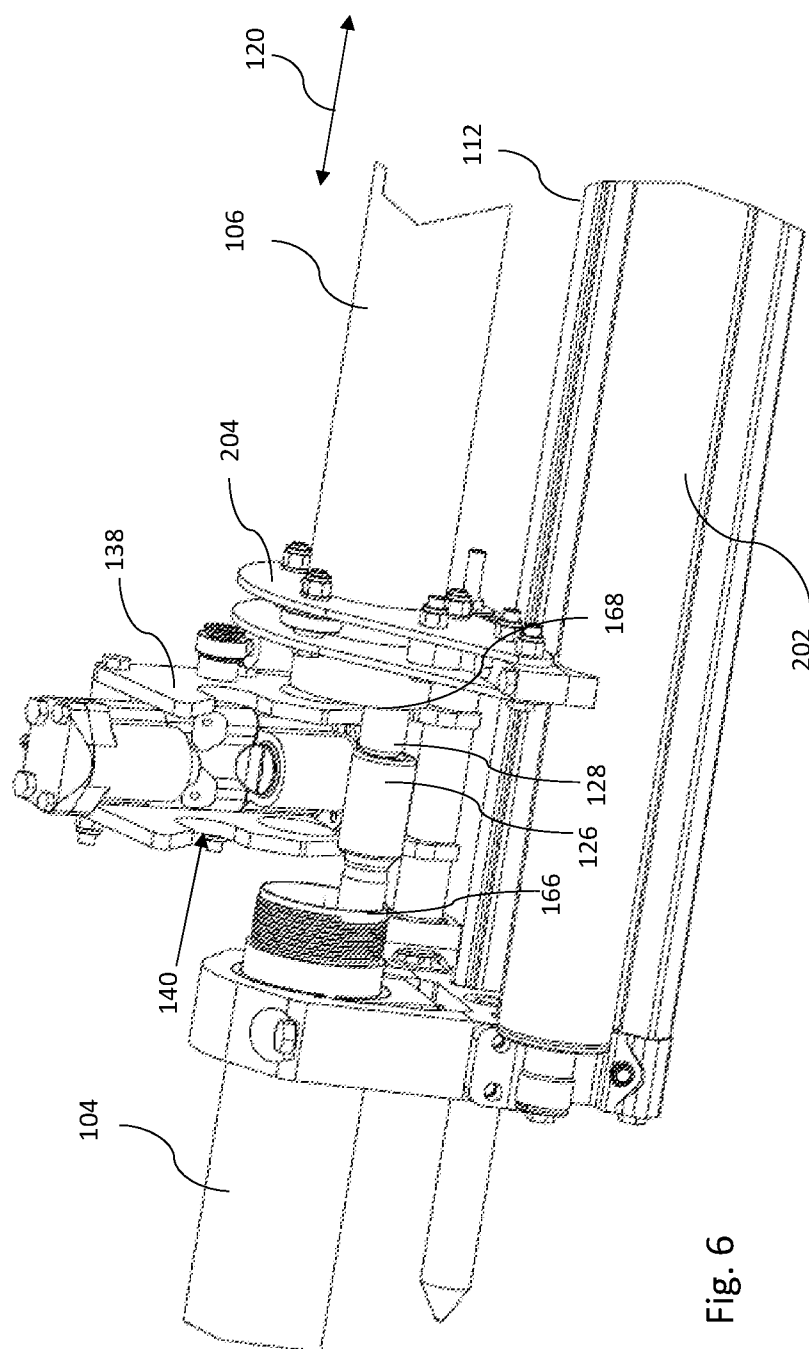


Fig. 5

6/17



Fi. 6

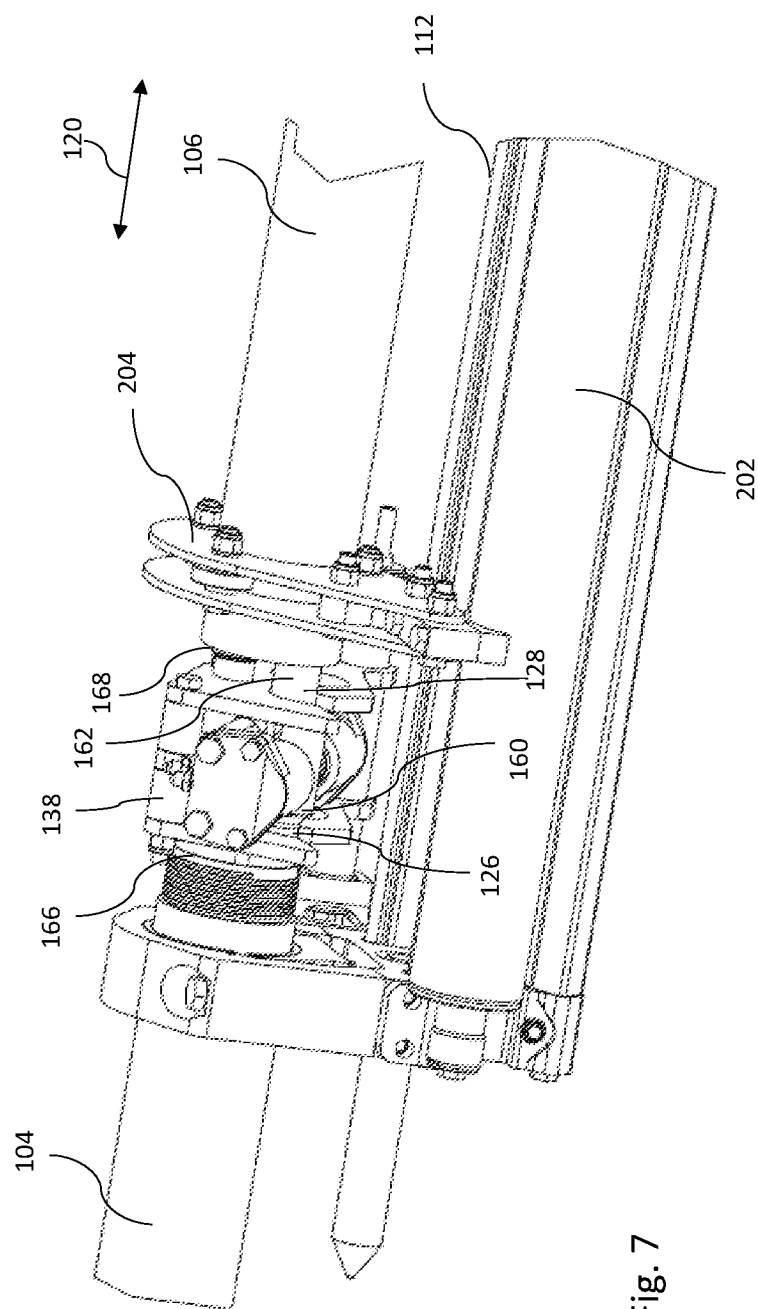


Fig. 7

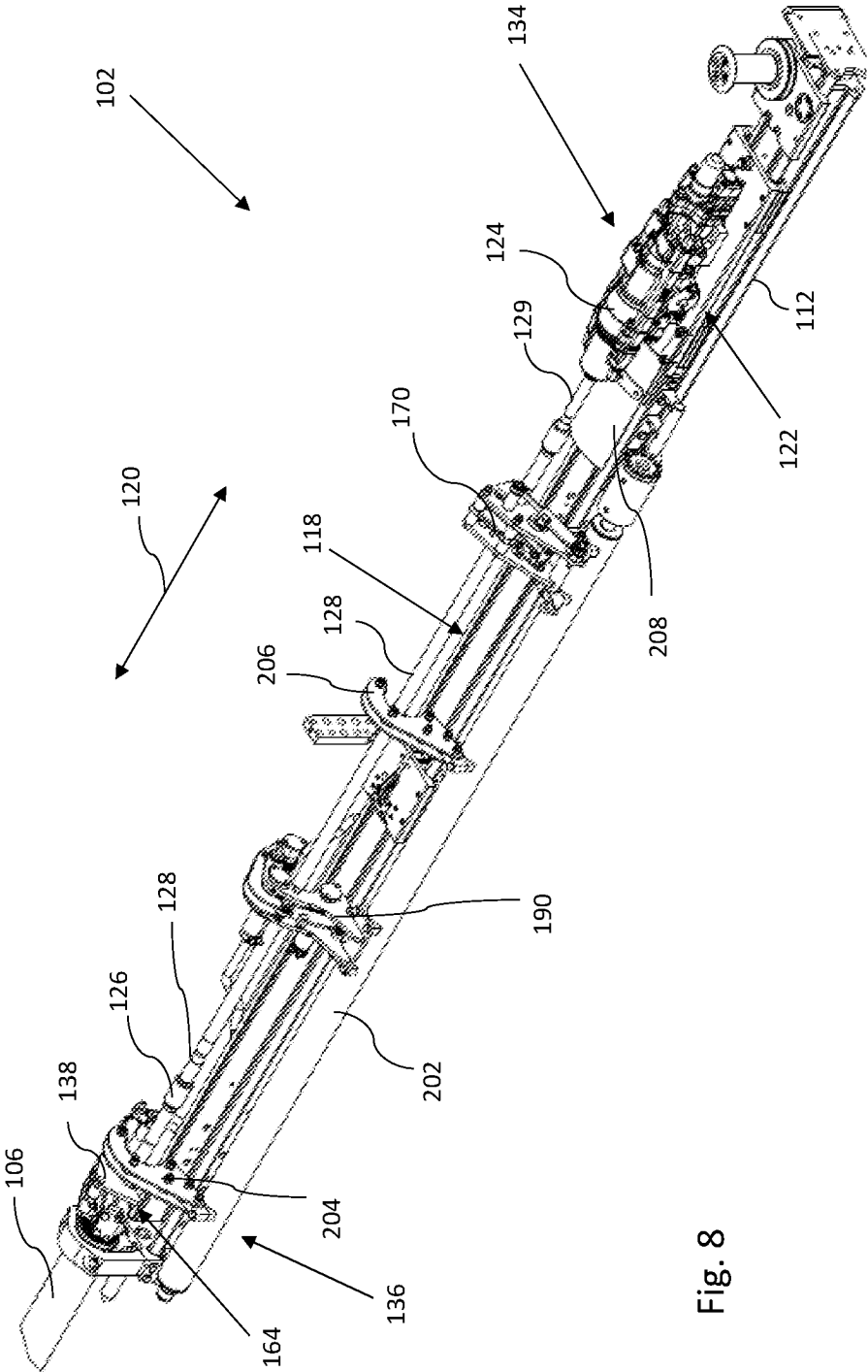


Fig. 8

9/17

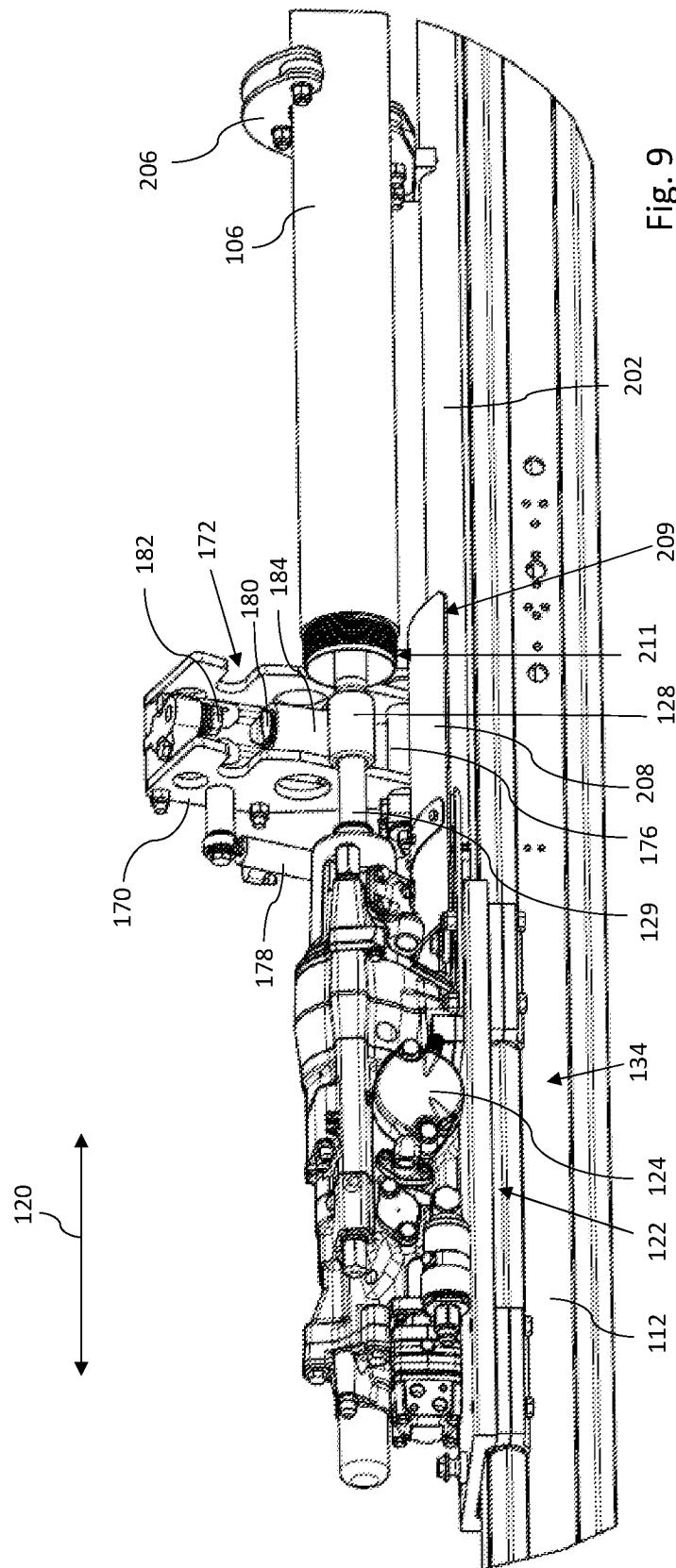


Fig. 9

10/17

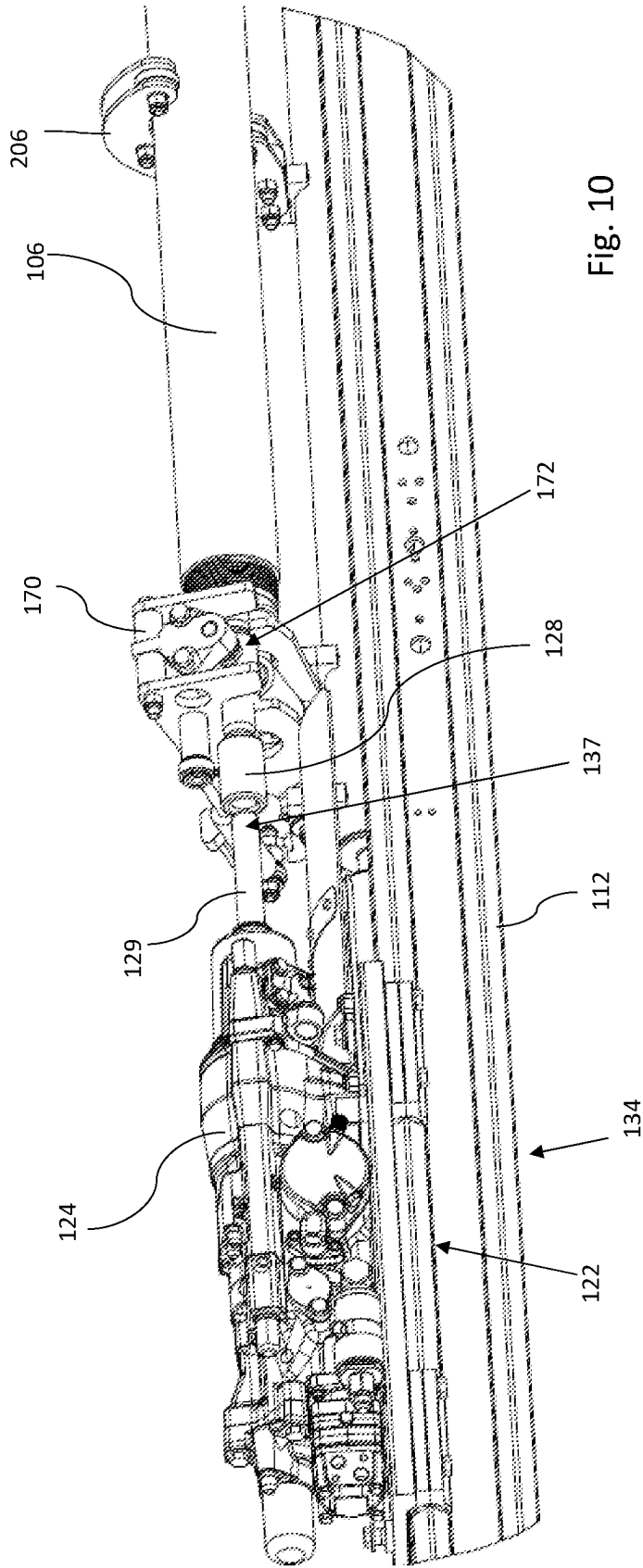


Fig. 10

11/17

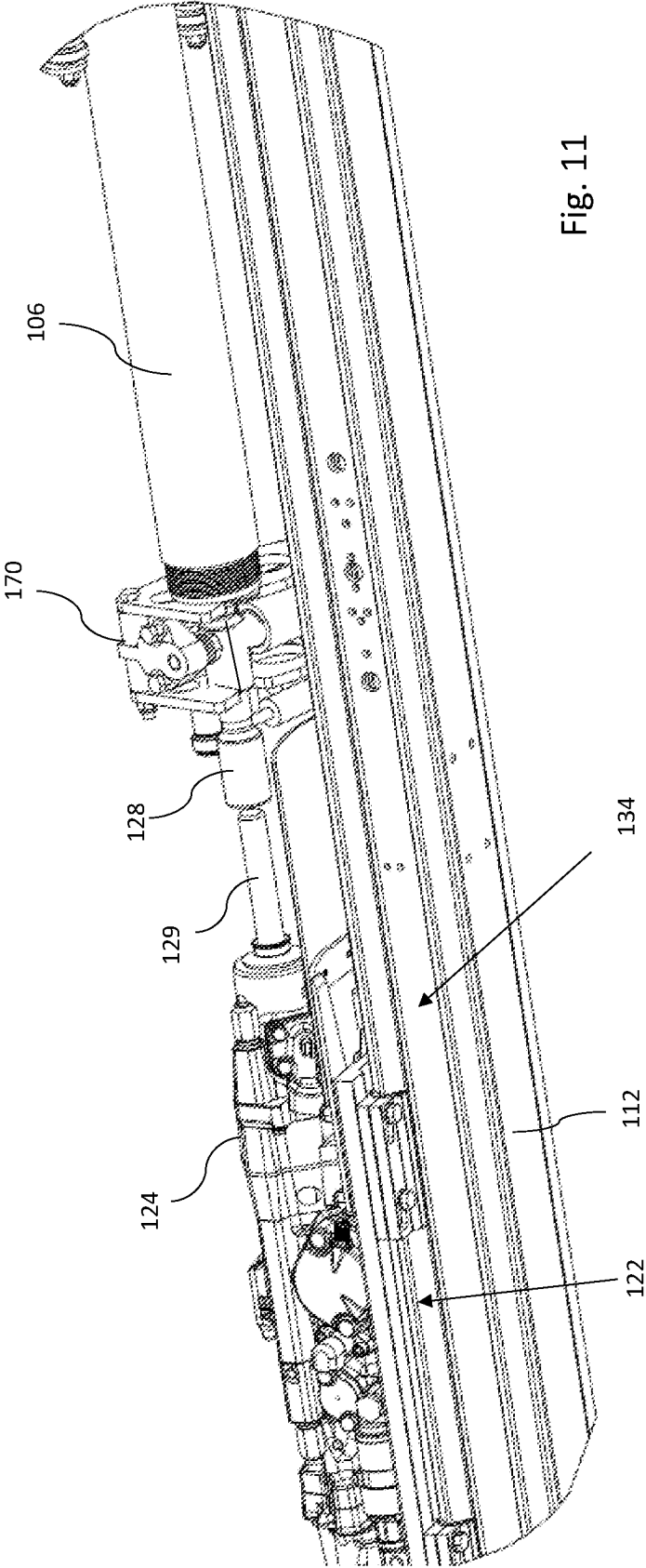


Fig. 11

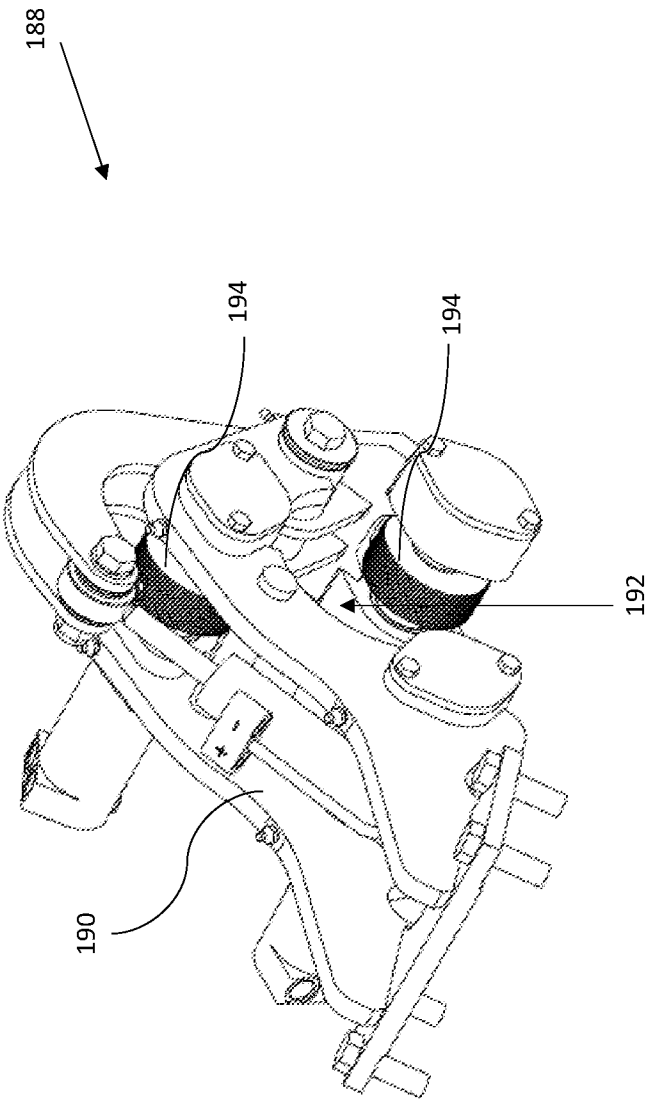


Fig. 12

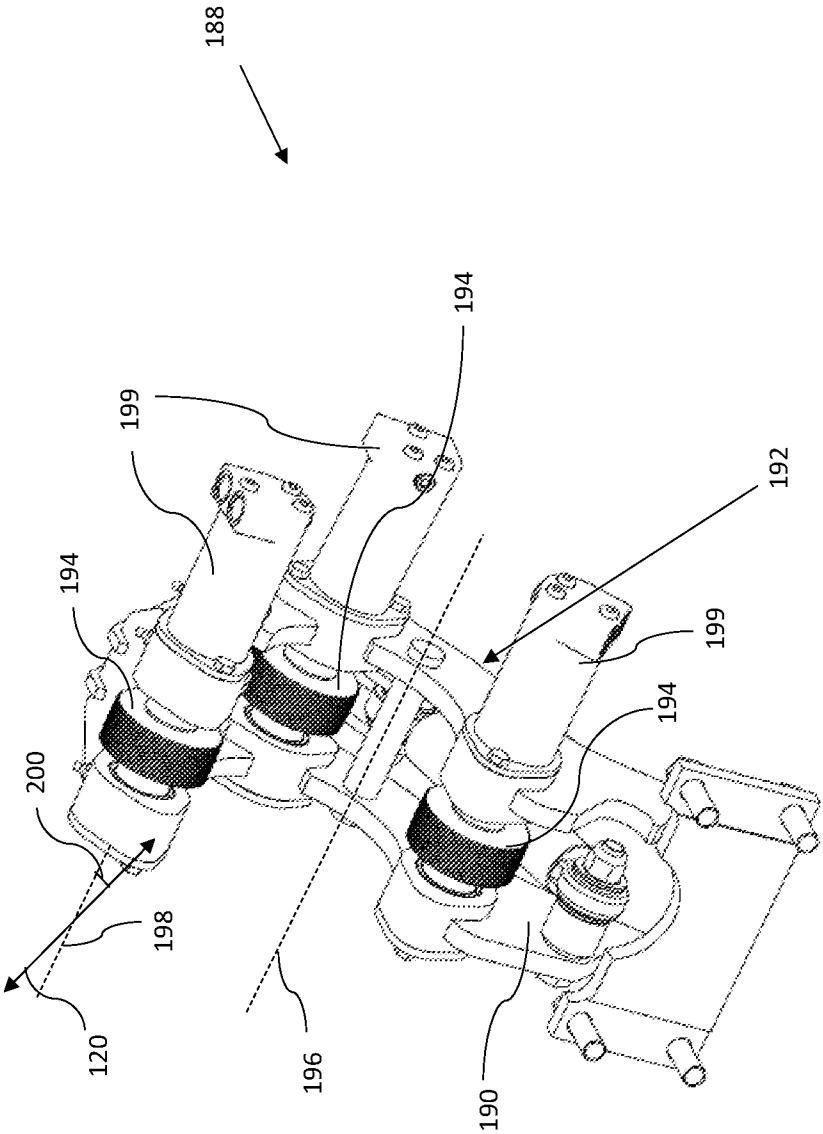


Fig. 13

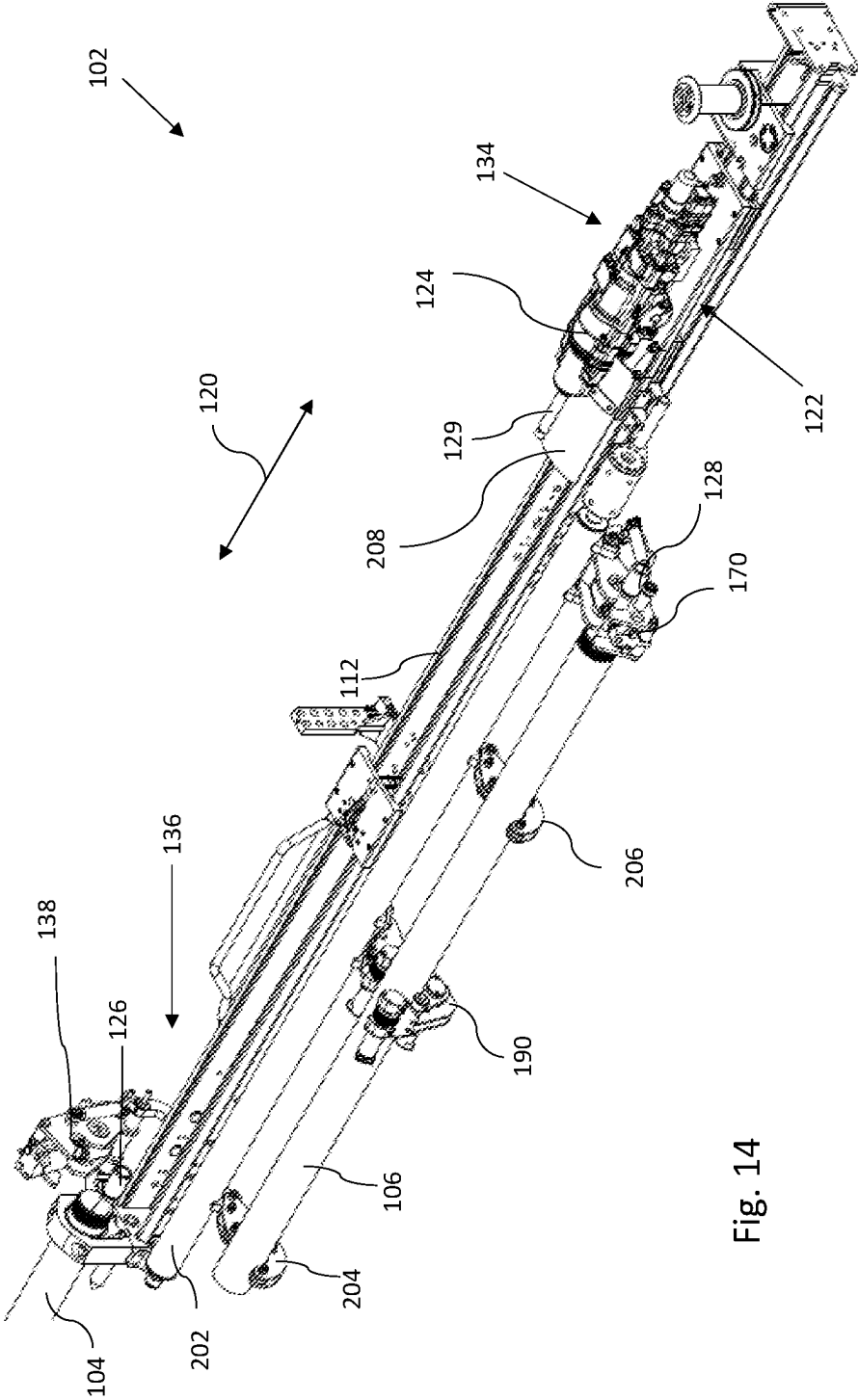


Fig. 14

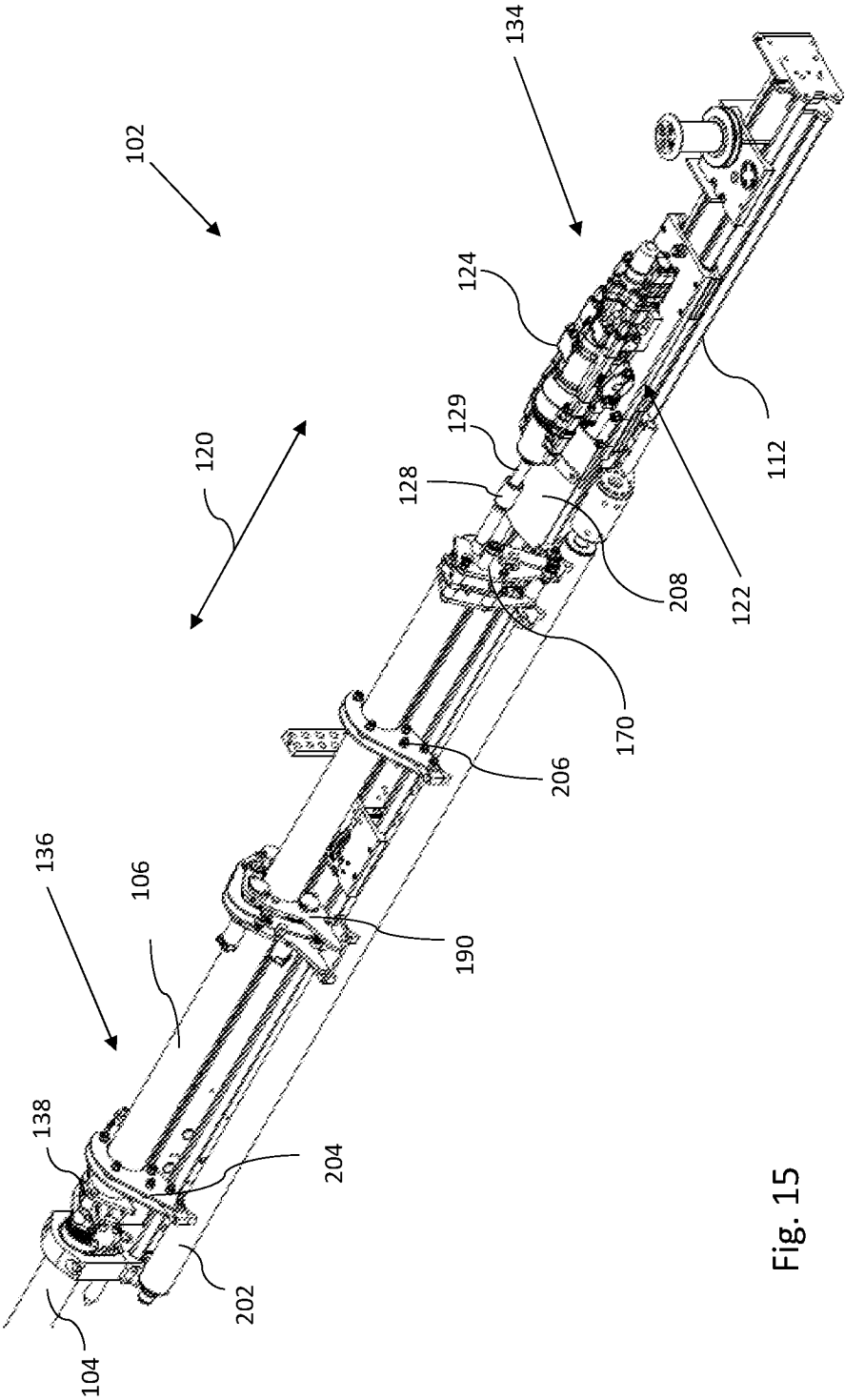


Fig. 15

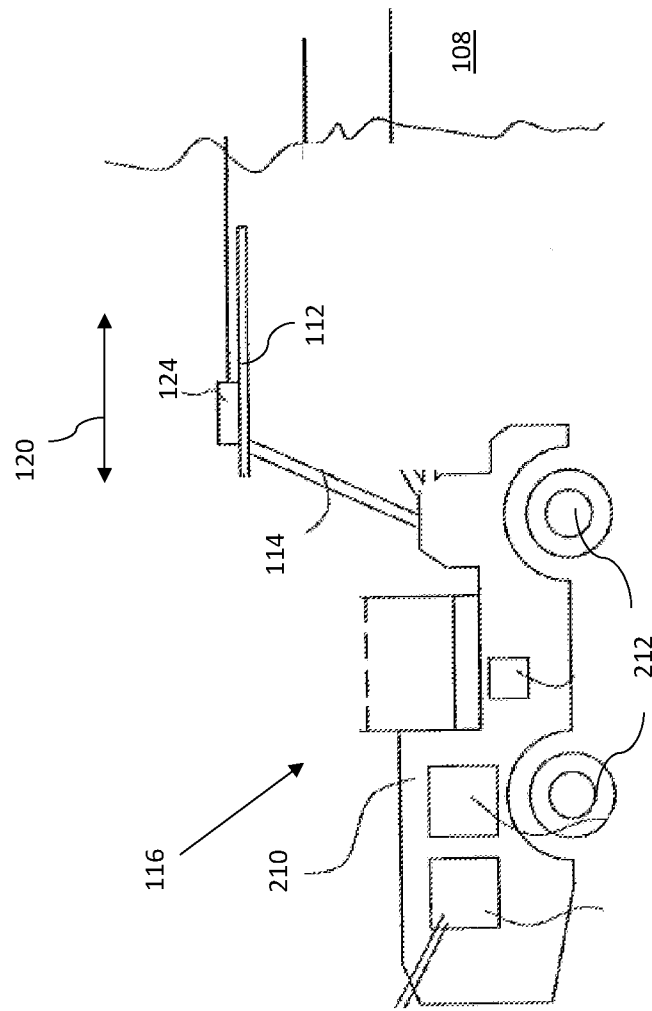


Fig. 16

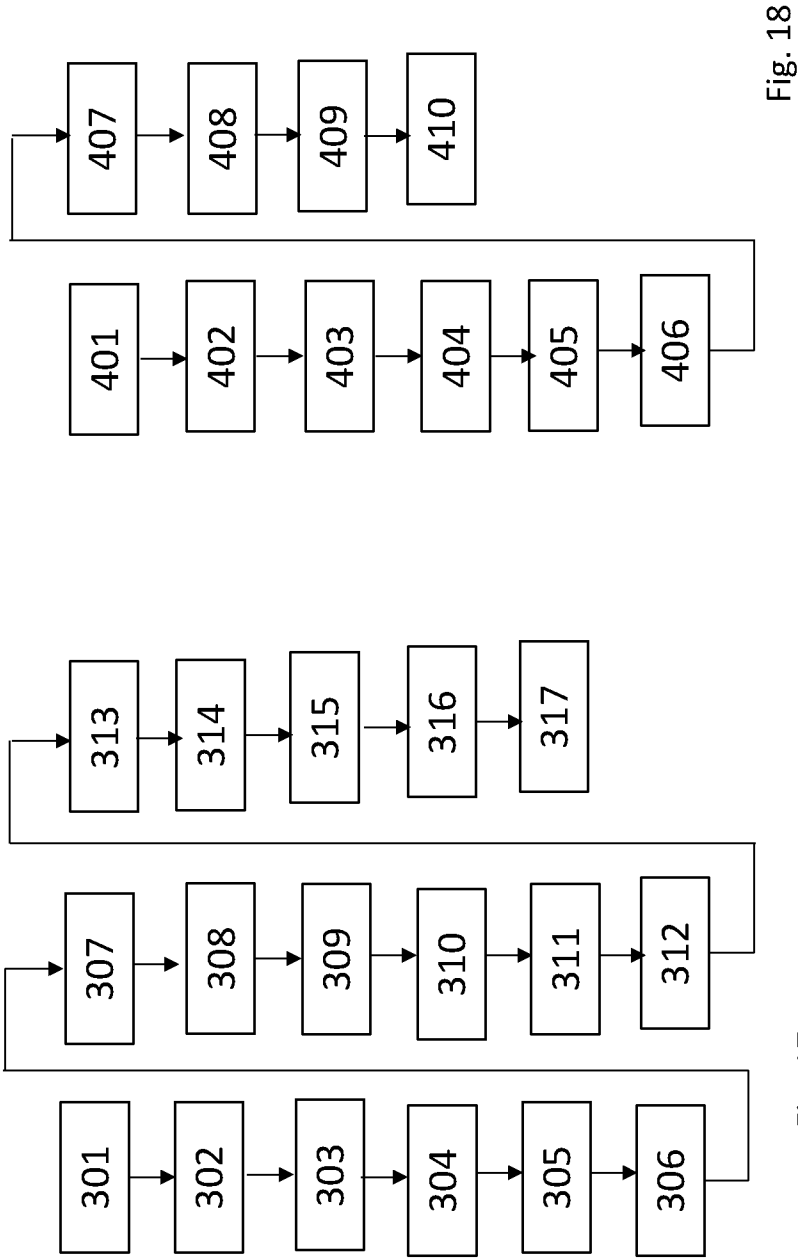


Fig. 17

Fig. 18

INTERNATIONAL SEARCH REPORT

International application No

PCT/SE2020/050263

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B19/08
ADD.

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

B. FIELDS SEARCHED

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

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2012/067579 A1 (ATLAS COPCO ROCK DRILLS AB [SE]; ERICSSON PATRIK [SE] ET AL.) 24 May 2012 (2012-05-24)	1,3,4, 6-8,13, 21,26, 27,29,30
A	figures 1,3A-3D	2,5, 9-12, 14-20,28
X	----- EP 0 565 502 A1 (NYMAN KARL ERIK [SE]) 13 October 1993 (1993-10-13) column 3, line 42 - column 8, line 45; figures 1-6	1,6,13, 26,27
X	----- US 4 102 409 A (LAGERSTEDT JOHN ARNE) 25 July 1978 (1978-07-25) the whole document ----- -/-	1,27



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

8 May 2020

Date of mailing of the international search report

13/07/2020

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Beran, Jiri

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2020/050263

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-21, 27-30(completely); 26(partially)

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No

PCT/SE2020/050263

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2006/061459 A1 (SANDVIK TAMROCK OY [FI]; PIIPPONEN JUHA [FI]) 15 June 2006 (2006-06-15) paragraphs [0022] - [0026], [0034]; figures 1,9,10 -----	1-21,26, 27

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/SE2020/050263

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2012067579	A1	24-05-2012	AU 2011329570 A1 20-06-2013
		CA 2817087 A1 24-05-2012	
		CN 103403288 A 20-11-2013	
		EP 2640922 A1 25-09-2013	
		PE 20140798 A1 09-07-2014	
		SE 1051208 A1 18-05-2012	
		US 2013216312 A1 22-08-2013	
		WO 2012067579 A1 24-05-2012	
		ZA 201303797 B 30-07-2014	
EP 0565502	A1	13-10-1993	DE 565502 T1 28-09-1995
			DE 69305678 T2 20-03-1997
			DK 0565502 T3 17-02-1997
			EP 0565502 A1 13-10-1993
US 4102409	A	25-07-1978	AU 512297 B2 02-10-1980
			CA 1061324 A 28-08-1979
			DE 2656209 A1 23-06-1977
			FR 2334813 A1 08-07-1977
			GB 1566428 A 30-04-1980
			JP S5272302 A 16-06-1977
			SE 414417 B 28-07-1980
			US 4102409 A 25-07-1978
WO 2006061459	A1	15-06-2006	AU 2005313303 A1 15-06-2006
			CA 2589788 A1 15-06-2006
			CN 101076651 A 21-11-2007
			EP 1831500 A1 12-09-2007
			FI 20045467 A 08-06-2006
			JP 4456155 B2 28-04-2010
			JP 2008523275 A 03-07-2008
			NO 332332 B1 03-09-2012
			RU 2351735 C1 10-04-2009
			US 2008011516 A1 17-01-2008
			WO 2006061459 A1 15-06-2006
			ZA 200704511 B 27-08-2008

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-21, 27-30(completely); 26(partially)

An apparatus for installing pipes having a guide on a feed beam, a feeder guided by said guide while sliding along the feed beam, a drilling machine on said feeder, whereby the apparatus further comprises a first arm attached to said feed beam and having a gripper, the first arm being movable between inactive and active positions.

2. claims: 22-24, 31(completely); 26(partially)

An apparatus for installing pipes having a guide on a feed beam, a feeder guided by said guide while sliding along the feed beam, a drilling machine on said feeder, whereby the apparatus further comprises a pipe feeding device for feeding and moving the pipe in relation to the feed beam, and an arm attached to the feed beam

3. claims: 25(completely); 26(partially)

An apparatus for installing pipes having a guide on a feed beam, a feeder guided by said guide while sliding along the feed beam, a drilling machine on said feeder, whereby the apparatus further comprises a muck shield attached to the feeder to cover a portion of the guide for guiding muck away from said guide.
