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(54) Title: CLAMPING APPARATUS, DRILL STRING COMPONENT AND ROCK DRILLING RIG

(57) Abrégé/Abstract:
The present invention relates to a clamping apparatus for use with a rock drilling rig. The clamping apparatus comprises first and second jaw means for jaw gripping a drill string component, the first and second jaw means comprising first and second gripping means, respectively, for gripping respective corresponding engagement means of a respective end portion of the drill string component. The clamping apparatus further comprises jaw actuating means. The engagement means are arranged so as to allow clamping independently of the rotational position of the drill string component as seen with respect to its axis of symmetry. The invention also relates to a drill string component and a rock drilling rig.

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WO 2005/098196 A1

(54) Title: CLAMPING APPARATUS, DRILL STRING COMPONENT AND ROCK DRILLING RIG

(57) Abstract: The present invention relates to a clamping apparatus for use with a rock drilling rig. The clamping apparatus comprises first and second jaw means for jaw gripping a drill string component, the first and second jaw means comprising first and second gripping means, respectively, for gripping respective corresponding engagement means of a respective end portion of the drill string component. The clamping apparatus further comprises jaw actuating means. The engagement means are arranged so as to allow clamping independently of the rotational position of the drill string component as seen with respect to its axis of symmetry. The invention also relates to a drill string component and a rock drilling rig.

CLAMPING APPARATUS, DRILL STRING COMPONENT AND ROCK DRILLING RIG.

Field of the invention

The present invention relates to a clamping apparatus according to the preamble of claim 1, a drill string component for use with such a clamping apparatus according to the preamble of claim 18, and a rock drilling rig including such a clamping apparatus according to the preamble of claim 23.

Background of the invention

In the process of rock drilling, a drill string having a reamer at its free end has to be assembled in accordance with the advancement of the reamer into the rock structure. Thus drill string components are accordingly joined so as to form the drill string, generally by screwing a new drill string component onto a proximal end of the advanced drill string. After further advancement of the reamer, a new drill string component is similarly added to the proximal end of the thus advanced drill string, and so on.

Disassembly of the drill string is carried out in the opposite way, i.e. the drill string is drawn into the drilling machine under successive loosening of the proximal drill string component from the rest of the drill string.

During assembling and disassembling, the drill string components have to be transported to the assembling area from a drill string component storage and vice versa. This transportation may be carried out in a number of ways, e.g. by hand-carrying the drill string components, by lifting them by means of lifting means or by transporting them on a conveyor, or a combination thereof. In a number of applications, at least part of the transportation is advantageously carried out

by means of a hoisting crane. When using a hoisting crane, the drill string component is clamped by means of jaw means, e.g. resembling a timber tong, and then transported to a desired location. One problem when using such clamping means, however, is that a large portion of the drill string component casing has to be accessible for the jaw means.

Object and most important features of the invention

It is an object of the present invention to provide a clamping apparatus for use with a rock drilling rig, which solves the above mentioned problem.

This object is achieved by a clamping apparatus according to the characterising portion of claim 1.

It is a further object of the present invention to provide a drill string component, which solves the above mentioned problem. This object is achieved by a drill string component as defined in the characterising portion of claim 18.

It is a further object of the present invention to provide a rock drilling rig, which solves the above mentioned problem. This object is achieved by a rock drilling rig as defined in the characterising portion of claim 23.

The clamping apparatus comprises first and second jaw means for gripping a drill string component, and jaw actuator means, the first and second jaw means comprising first and second gripping means, respectively, for gripping respective corresponding engagement means of a respective end portion of the drill string component, wherein said engagement means are arranged so as to allow clamping independently of the rotational position of the drill string component as seen with

respect to its axis of symmetry. The engagement means may be complementary to the gripping means, and/or vice versa.

This has the advantage that the drill string components may be stacked side by side and on top of each other, and still be accessible by the clamping apparatus for transport, e.g. to a derrick.

The clamping apparatus may further comprise means for self aligning the first and second jaw means with the longitudinal axis of the drill string component. The means for self aligning may include a pivoting joint and curved alignment surfaces on a portion of the first and second jaw means, respectively.

This has the advantage that no fine adjustment of the gripping position is necessary. Further, the present invention may be used in situations where the drill rod components are to be clamped or released on an inclined surface.

One of said gripping means and said engagement means may consist of an annular or curved groove or slot, and the other of said means may consist of an annular or curved portion from the group: rib, or one or more projecting parts from the group: pins. For example, when said engagement means consists of an annular groove or slot, said gripping means may consist of said curved portion or at least one of said projecting parts.

This has the advantage that clamping independently of the rotational position of the drill string component as seen with respect to its axis of symmetry may be accomplished in a relatively easy way.

Clamping may be arranged to be effected by relatively moving at least one of said first or second gripping means in a direction towards the other gripping means, the direction substantially corresponding to the longitudinal axis of said drill string component. The clamping apparatus may further comprise actuating means for relatively moving at least one of said first or second gripping means in respect of the other gripping means by relatively moving at least one of said first and second jaw means. The actuating means may be constituted by at least one hydraulic motor, e.g. a hydraulic cylinder, or a pneumatic motor or an electric motor.

The clamping apparatus may further comprise means for tilting the drill string component when and/or after clamping the drill string component. The tilting means may be arranged such that the tilting angle can be continuously variable, e.g. from -25° to 25°, from -90° to 90° or from 0° to 25°. The tilting means may consist of at least one hydraulic motor, e.g. a hydraulic cylinder, a pneumatic motor or an electric motor.

This has the advantage that it is always possible keep the drill string component substantially horizontal with respect to its longitudinal axis, irrespective of the longitudinal position of the centre of gravity when transporting the drill string component. Further, this has the advantage that when the drill string component is to be positioned on an inclined surface, the drill string component may be tilted prior to surface contact so as to ensure a drop-off with minor stress on the drill string component.

The connection means may consist of a universal joint for connection to a hoisting crane. This has the advantage that it reduces stress on the crane jib.

Brief description of the drawings

Fig. 1 is a section through a drift extending through a rock and a rock drilling rig therein for drilling a series of intersecting holes.

Fig. 2 shows a front view of the rock drilling of fig. 1.

Figs. 3a-b show a clamping apparatus and a drill string component according to the present invention.

Figs. 4a-e show various states when clamping a drill string component with a clamping apparatus according to the present invention.

Figs. 5a-b show self-alignment of the clamping apparatus according to the present invention.

Detailed description of exemplary embodiments

In figs. 1 and 2 is shown a rock drilling rig 1 suitable for use with the present invention. In Fig. 1 the rock drilling rig 1 is shown having at its right end a compartment 5 for storing drill string components 2' to be assembled into a drill string. A derrick 8 includes assembling means for assembling the drill string components into a drill string which is getting longer during the drilling process. The assembling means may include a holding wrench.

In fig. 2 is shown a front view of the rock drilling rig in an ongoing drilling process. As is shown, the apparatus 1 is used to excavate an inclined cylindrical portion of a rock formation. The drilling is performed by a reamer 3 with a relatively larger diameter mounted together with a pilot bit 4 of a smaller diameter. The pilot bit is used to ascertain that

the drilling is performed in a desired direction throughout the drilling of the particular hole. The reamer 3 is carried by a drill string 2, at present constituted by drill string components 2a, 2b, 2c, where additional drill string components 2d, 2e, etc. (not shown) may be added to the drill string by the assembling device as the drilling process progresses until a hole of desired length has been acquired. Each drill string component 2' may for example be of 1000 mm length.

Each time a new drill string component has to be added to the drill string 2, the drill string component has to be moved from the drill string compartment 5 to the derrick 8. Conversely, each time a drill string component has to removed from the drill string, i.e. when drilling of the particular hole is finished and the drill string is pulled out from the drilled hole and disassembled, the drill string component has to be moved from the derrick 8 to the drill string compartment. The movement of the drill string component may be carried out in a number of ways, e.g. by moving the components by means of a conveyor, a hoisting crane or a combination thereof. In respect of the present invention, the drill string components are moved at least part of the way by means of a hoisting crane. In the prior art, this hoisting has been carried out by using jaw means resembling a timber tong, which engages the outside surface of the drill string component with the jaws of the tong. One problem with the use of such clamping means is, however, as is mentioned above, that a large portion of the drill string component surface has to be accessible for the jaws, which makes efficient drill string component storage difficult. Efficient drill string component storage is important when the drill string components are carried on the drilling machine itself, in particular when the

machine is suited for operation in narrow drifts, such as the machine described in figs. 1 and 2.

In figs. 3a-b are shown a clamping apparatus 9 according to the present invention that advantageously may be used together with hoisting means to move drill string components to/from the drill string compartment. The clamping apparatus 9 comprises a rotator 10 for coupling to hoisting means, e.g. via a universal joint 11 as shown in the figure. The rotator 10 is connected to first and second jaw means 12, 13. In the exemplary embodiment shown in figs. 3a and 3b, the first jaw means 13 is fixed to the rotator by means of a pivot joint 20. As is shown in the figure, the first and second jaw means are mounted on two bars 21, 22. The first jaw means 12 is rigidly connected to the bars by means of clamp bushings not explicitly shown, though indicated at 24a-d, and the second jaw means 13 is slidably mounted on the two bars by means of sliding bearings 23a-d. As can be seen in the figures, the first and the second jaw means are thus aligned by means of the two bars 21 and 22. Further, the first and second jaw means are coupled together by means of a hydraulic cylinder 25.

The first and second jaw means comprise first and second gripping means 14, 15, respectively, for gripping respective corresponding engagement means 16 and 17, located at each end portion of the drill string component 30.

In the figure, the engagement means 16, 17 consist of an annular groove at the outer periphery of each drill string component end. The annular grooves are symmetrical and thus allow clamping of the drill string component independently of the rotational position of the drill string component, as seen

with respect to its axis of symmetry A-A. Further, in fig. 3b, the gripping means 14, 15 of the jaw means consist of a curved rib portion in form of e.g. part of a ring, the curvature corresponding to the curvature of the groove(s) and the height substantially corresponding to, but not being greater than, the groove width such that the gripping means may be introduced into the groove(s) 16, 17. Thus, the gripping means are complementary to the engagement means.

When clamping the drill string component, the clamping apparatus 9 is lowered towards the drill string component, as is shown in fig. 4a. When the clamping apparatus 9 is lowered such that it abuts against the drill string component 30, shown in fig. 4b, clamping is effected by relatively moving the jaw means 12 and 13 towards each other. This is effected by operating the hydraulic cylinder 25 such that its piston is pulled into the cylinder housing, which pulls the second jaw means 13 towards the first jaw means 12, which in turn causes the first and second gripping means 14, 15 to be introduced into the corresponding grooves 16, 17 in the drill string component. The clamping apparatus is now secured to the drill string component, and the drill string component may be lifted and transported by connecting suitable hoisting means to the universal joint 11. Connection of the clamping apparatus to hoisting means via a universal joint is advantageous since this reduces stress on e.g. a hoisting crane jib.

The clamping apparatus is further provided with a second hydraulic cylinder 26. This cylinder, in combination with the pivoting joint 20, provides the apparatus with the ability to tilt the drill string component. This is illustrated in figs. 4d, where the drill string component is tilted towards the left, and in fig. 4e where the drill string component is

tilted towards the right. In the shown exemplary embodiment, the tilting angle may be continuously varied from -25° to 25°, with respect to a horizontal plane. Of course, other tilting angle ranges, such as from -90° to 90° or from 0° to 25°, are possible. As is apparent to a person skilled in the art, a tilting angle range such as from -90° to 90° requires a modified tilting mechanism. Performing this modification, however, is considered to be a skill of the skilled person. Tilting of the drill sting component makes it possible to keep the drill string component substantially horizontal with respect to its longitudinal axis, irrespective of if the universal joint 11 is vertically aligned with the centre of gravity of the drill string component. Further, this has the advantage that when the drill string component is to be positioned on an inclined surface, the drill string component may be tilted prior to surface contact so as to ensure a drop-off with minor stress on the drill string component.

The pivot joint 20 has a further advantage as will be described in connection with figs. 5a-b. If, as is shown in fig. 5a-b, the drill string component rests on an inclined surface, the pivoting joint 20 may be used to self align the first and second jaw means with the longitudinal axis of the drill string component. When the clamping apparatus 9 in fig. 5a is lowered towards the drill string component, the clamping apparatus will first abut against the right most end of the drill string component as shown in fig. 5a. However, as the lowering of the clamping apparatus is continued, the pivoting joint 20 will cause the lowering of the leftmost end of the clamping apparatus to continue until both the first and the second jaw means abut, and are aligned with, the drill string component, shown in fig. 5b, whereupon the drill string component may be clamped as described above.

In order to facilitate self alignment, the jaw means may include guide members 28a, 29a and 29b, shown in fig. 3b. These members 28a, 29a and 29b are arranged on the surfaces 28 and 29 and directed towards the drill string component when the clamping apparatus is positioned. They are preferably curved with a radius substantially corresponding to the radius of the drill string component. The guide members may be replaceable so as to allow the size and form of the guide members to be varied to allow the clamping apparatus to suite various drill string components, e.g. drill string components of different diameters. Also, the position and number of guide members on the surfaces 28 and 29 may be varied. As an alternative, the guide members may be omitted, in which case the surfaces 28 and 29 may be used as alignment surfaces, preferably curved with a radius substantially corresponding to the radius of the drill string component.

The above described clamping apparatus further has the advantage that neither threads used for connecting drill string components to each other, nor contact surfaces (shown in fig. 3 on one end of the drill string component, indicated at 18), which abut each other when drill string components are to be connected to each other, are subjected to any interference of gripping means during lifting/transportation of the drill string components. This is very important since it is vital to keep these threads and contact surfaces intact in order to achieve a proper drilling process.

In the above description, the drill string component is provided with the grooves and the clamping apparatus is provided with the gripping ribs. In an alternative embodiment, the drill string component is provided with annular engagement

ribs, and the clamping apparatus with corresponding recesses arranged such that a portion of the annular rib fits therein. Further, the gripping/engagement ribs may instead of ribs be constituted by other projecting parts, such as e.g. pins.

The above described clamping apparatus may be adapted to fit drill string components of various lengths, e.g. by varying the length of the jaw means or the length of the hydraulic cylinder(s) so that one clamping apparatus may be used for two or more drill string component lengths.

In the above description the clamping apparatus has been shown as comprising first and second jaw means, where the second jaw means is movably connected to the first jaw means, and where the first jaw means is connected to hoisting means via the pivoting joint. In an alternative embodiment, the clamping apparatus further comprises a centre portion which is connected to the hoisting means, and wherein the first and the second jaw means are connected to the centre portion via actuating means and sliding bearings. Alternatively, only one of the jaw means may be movably connected to the centre portion, and the other jaw means may be rigidly connected to the centre portion.

Claims

1. Clamping apparatus for use with a rock drilling rig, comprising first and second jaw means for jaw gripping a drill string component, the clamping apparatus further comprising jaw actuating means, **characterised in** that
- said first and second jaw means comprise first and second gripping means, respectively, for gripping a respective corresponding engagement means of a respective end portion of the drill string component, said engagement means being arranged so as to allow clamping independently of the rotational position of the drill string component as seen with respect to its axis of symmetry.

2. Clamping apparatus according to claim 1, **characterised in** that it that the engagement means are complementary to the gripping means and/or vice versa.

3. Clamping apparatus according to claim 1 or 2, **characterised in** that it comprises means for self aligning the first and second jaw means with the longitudinal axis of the drill string component.

4. Clamping apparatus according to claim 3, **characterised in** that the means for self aligning include a pivoting joint and curved alignment surfaces on a portion of the first and second jaw means, respectively.

5. Clamping apparatus according to any of the claims 1-4, **characterised in** that one of said gripping means and said engagement means consists of an annular or curved groove or slot, and that the other of said means consists of an annular or curved portion from the group: rib, or one or more projecting parts from the group: pins.

6. Clamping apparatus according to claim 5, **characterised in** that said engagement means consists of an annular groove or slot, and that said gripping means consists of said curved portion or at least one of said projecting parts.

7. Clamping apparatus according to claim 5, **characterised in** that said gripping means consists of a curved groove or slot, and that said engagement means consists of at least one curved portion, an annular portion or at least one of said projecting parts.

8. Clamping apparatus according to any of the claims 1-7, **characterised in** that clamping is arranged to be effected by relatively moving, by means of actuating means, at least one of said first or second gripping means in a direction towards the other gripping means substantially corresponding to the longitudinal axis of said drill string component.

9. Clamping apparatus according to claims 8, **characterised in** that it comprises actuating means for relatively moving at least one of said first or second gripping means in respect of the other gripping means by relatively moving at least one of said first and second jaw means.

10. Clamping apparatus according to claim 8 or 9, **characterised in** that said actuating means are constituted by an actuator of the group: hydraulic motor, pneumatic motor, electric motor.

11. Clamping apparatus according to any of the preceding claims, **characterised in** that it further comprises means for tilting the drill string component when and/or after clamping the drill string component.

12. Clamping apparatus according to claim 11, **characterised in** that the tilting means is arranged such that the tilting angle can be continuously variable, e.g. from -25° to 25°, from -90° to 90° or from 0° to 25°.

13. Clamping apparatus according to claim 11 or 12, **characterised in** that the tilting means consist of at least one actuator from the group: hydraulic motor, pneumatic motor, electric motor.

14. Clamping apparatus according to any of the preceding claims, **characterised in** that it further comprises connection means for connection to lifting means.

15. Clamping apparatus according to claim 14, **characterised in** that the connection means consists of a universal joint.

16. Clamping apparatus according to any of the claims 14-15, **characterised in** that the first jaw means is connected to a coupling portion, e.g. a rotator, connected to said connection means via said pivoting joint, and that the second jaw means is movably connected to the first jaw means.

17. Clamping apparatus according to any of the claims 1-15, **characterised in** that
- it further comprises a middle portion, which is connected to said means for connection to lifting means via said pivoting joint,
- the first jaw means and the second jaw means are connected to the middle portion, and
- at least one of the first jaw means and the second jaw means are movably connected to said middle portion.

18. Drill string component for use with a clamping apparatus according to any of the claims 1 - 17, **characterised in** that the drill string component at its ends comprises first and second engagement means, respectively, for receiving corresponding gripping means of the clamping apparatus, wherein said engagement means are arranged so as to allow reception of the corresponding gripping means independently of the rotational position of the drill string component as seen with respect to its axis of symmetry.

19. Drill string component according to claim 18, **characterised in** that the engagement means are positioned radially outside the drill string connecting threads.

20. Drill string component according to claim 18 or 19, **characterised in** that it that the engagement means are complementary to the gripping means and/or vice versa.

21. Drill string component according to any of the claims 18-20, **characterised in** that said engagement means consist of annular or curved grooves or slots.

22. Drill string component according to any of the claims 18-21, **characterised in** that said engagement means consists of at least one annular or curved portion from the group: rib; or at least one projecting part from the group: pins.

23. Rock drilling rig, including a clamping device according to any of the claims 1 - 17 for clamping drill string components when lifting and/or transporting the drill string components.

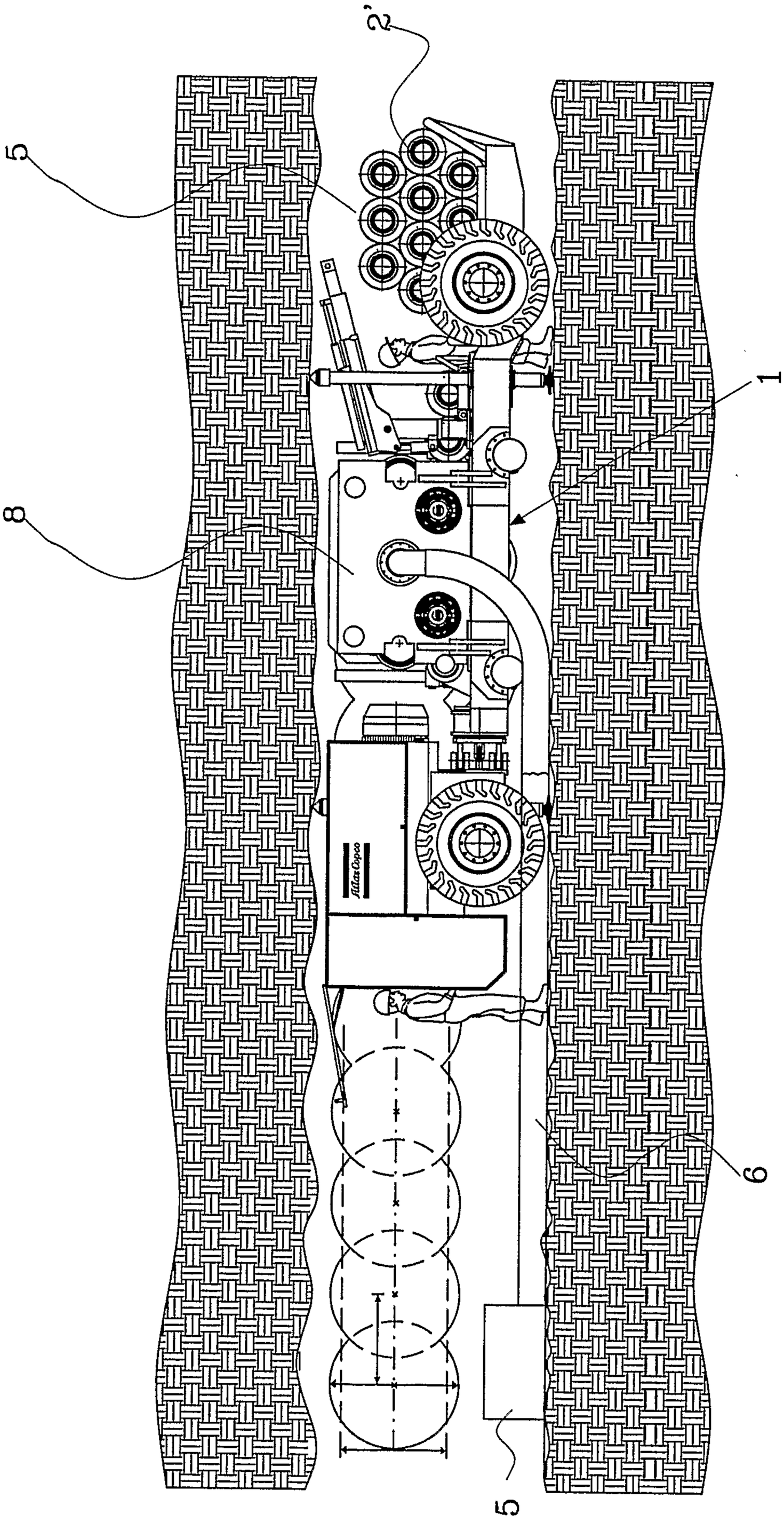


Fig. 1

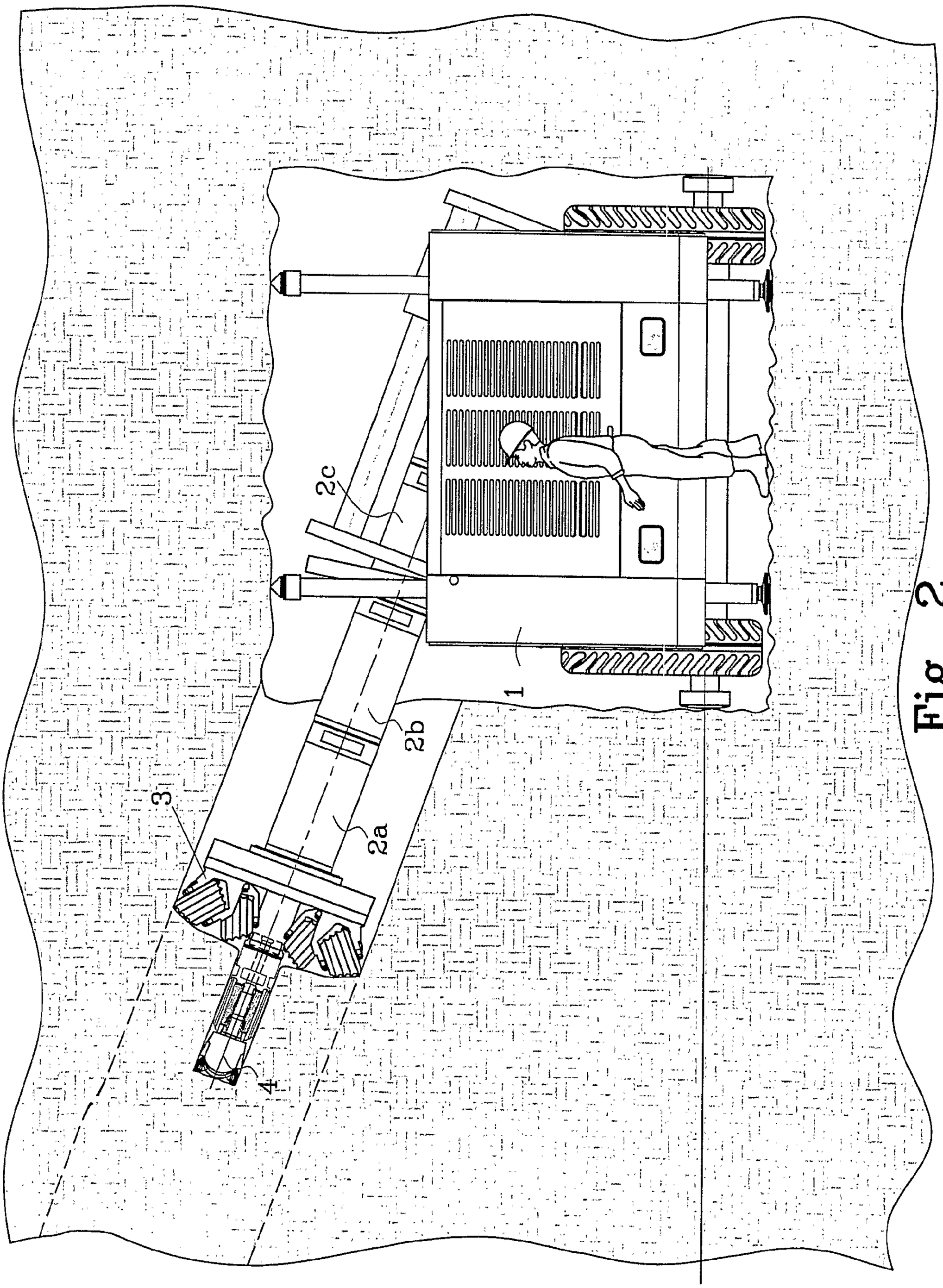


Fig. 2

Fig. 3a

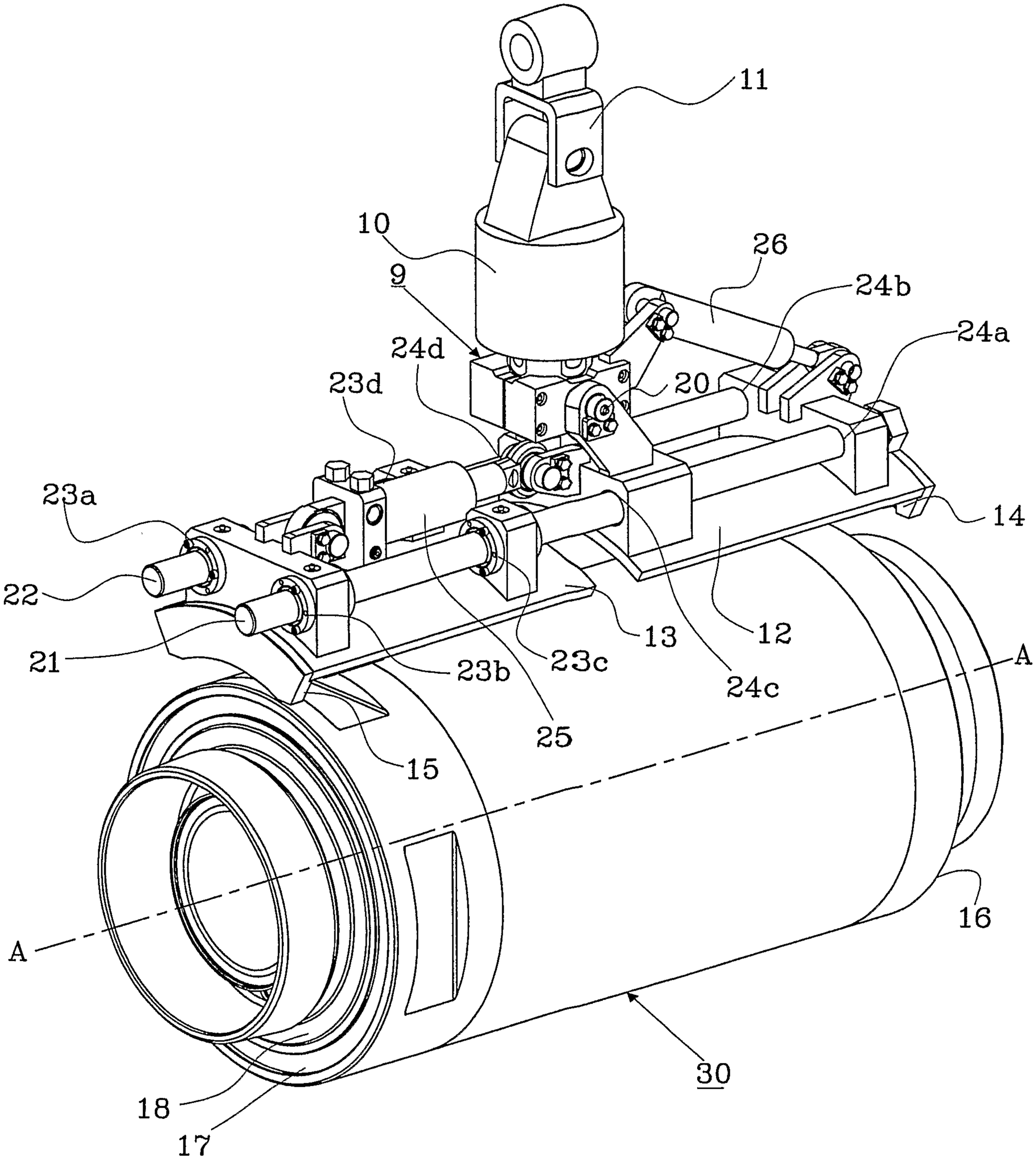

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Fig. 3b

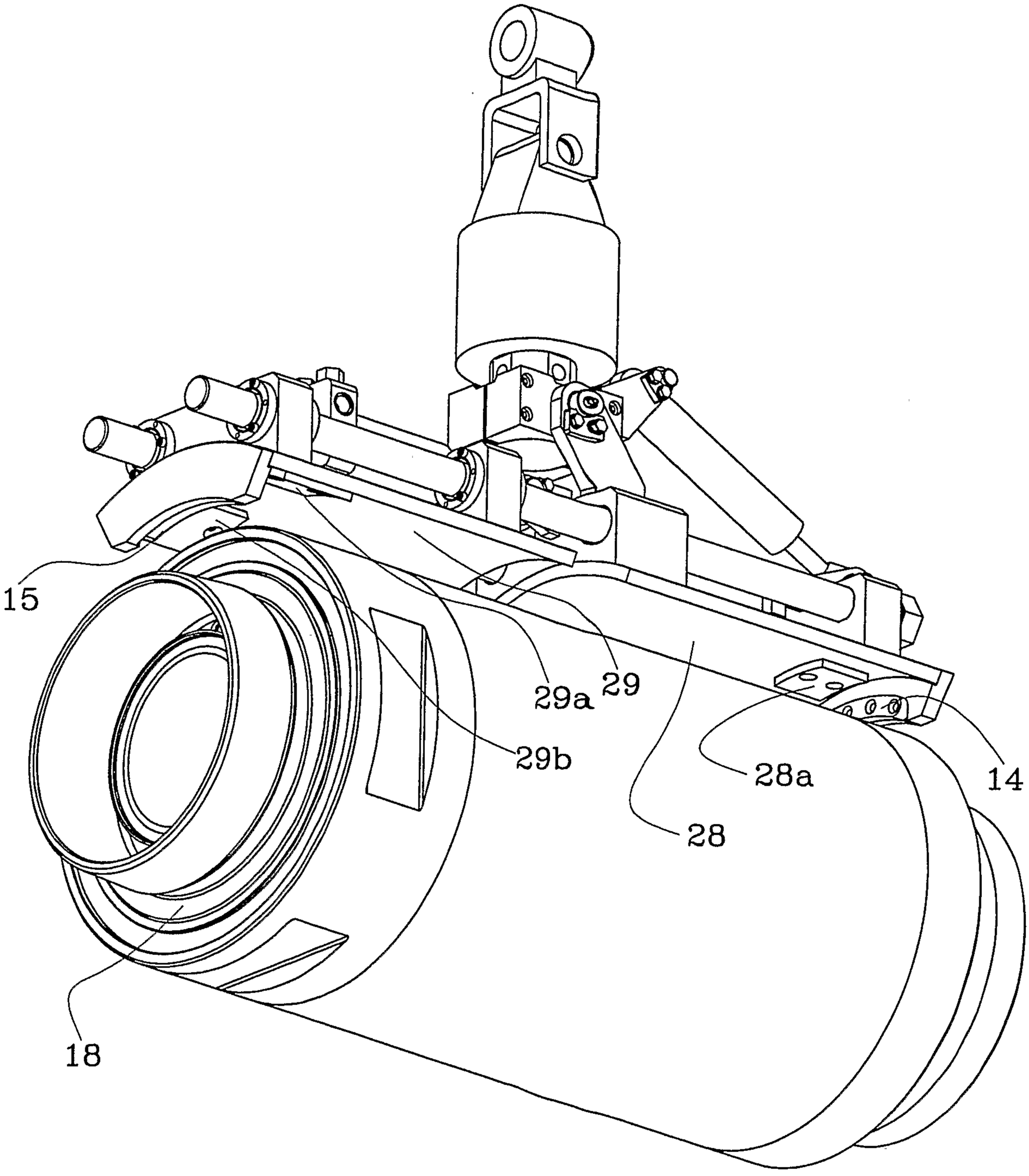


Fig. 4a

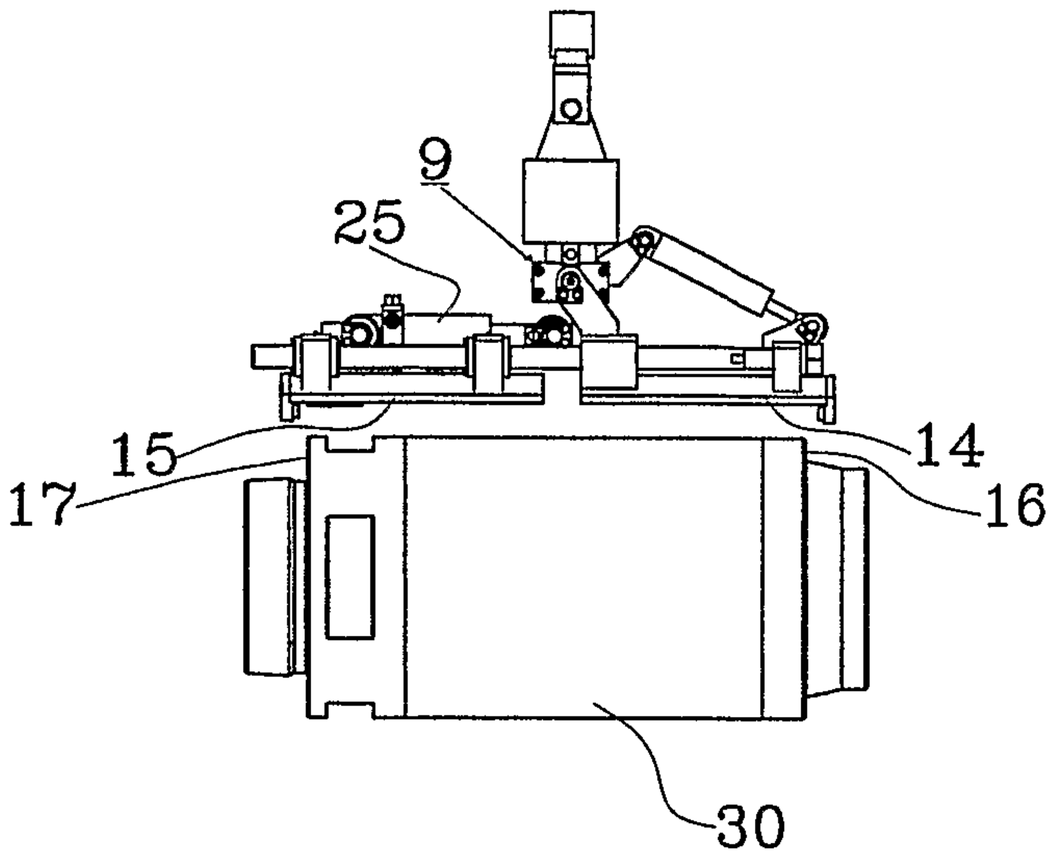


Fig. 4b

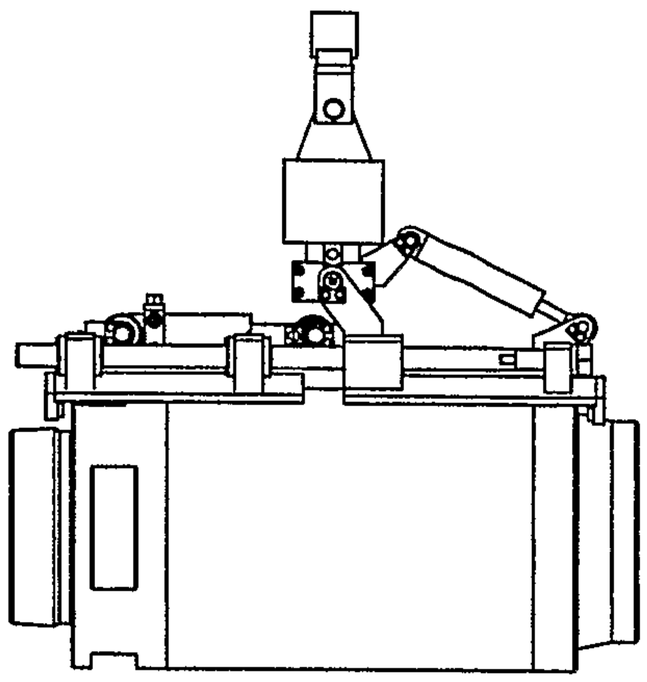


Fig. 4c

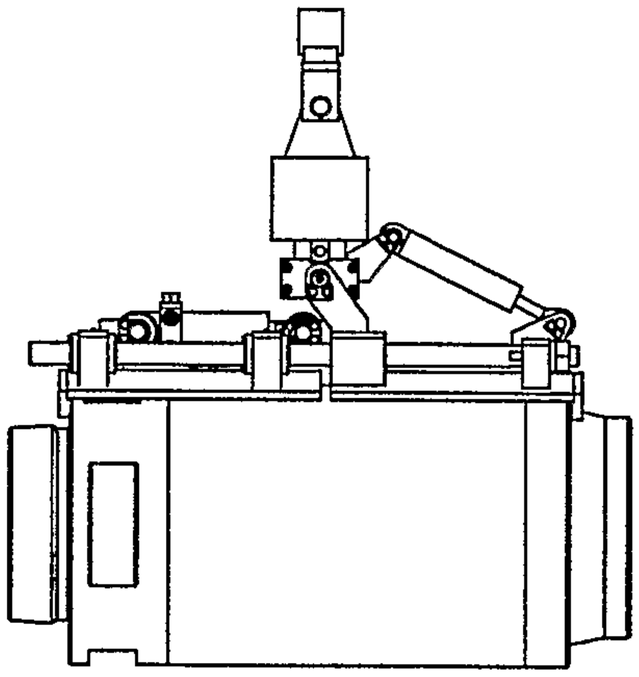


Fig. 4d

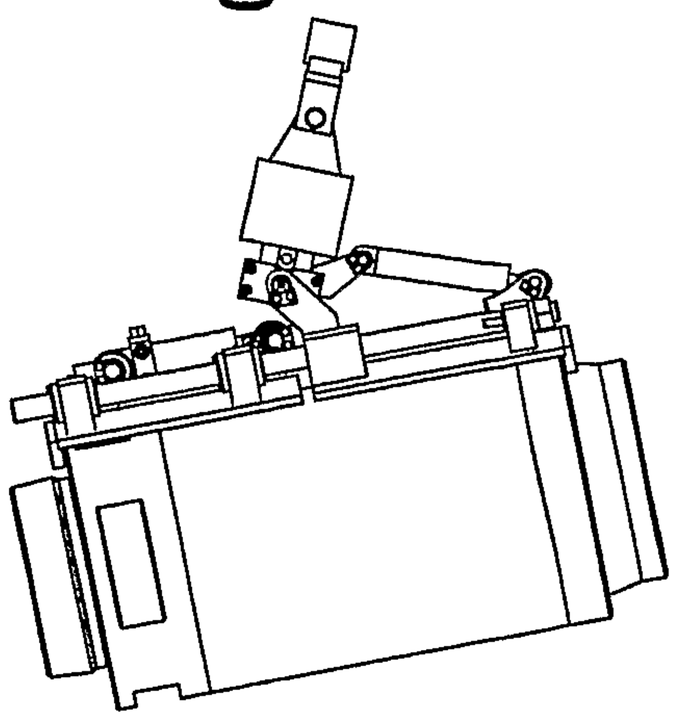


Fig. 4e

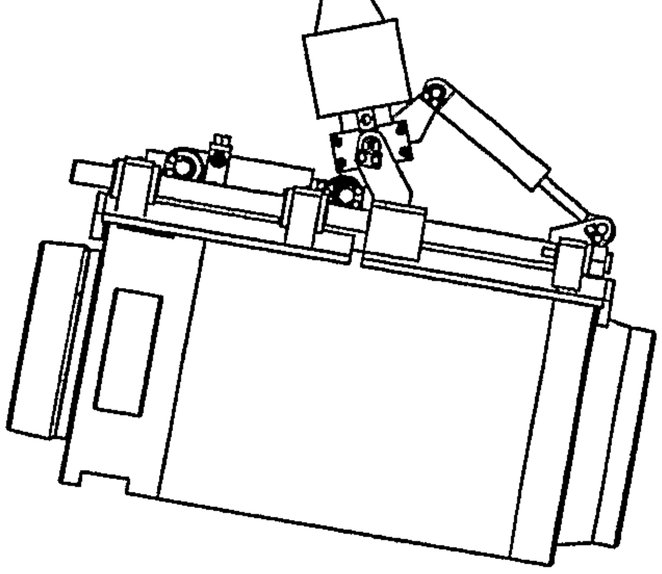


Fig. 5a

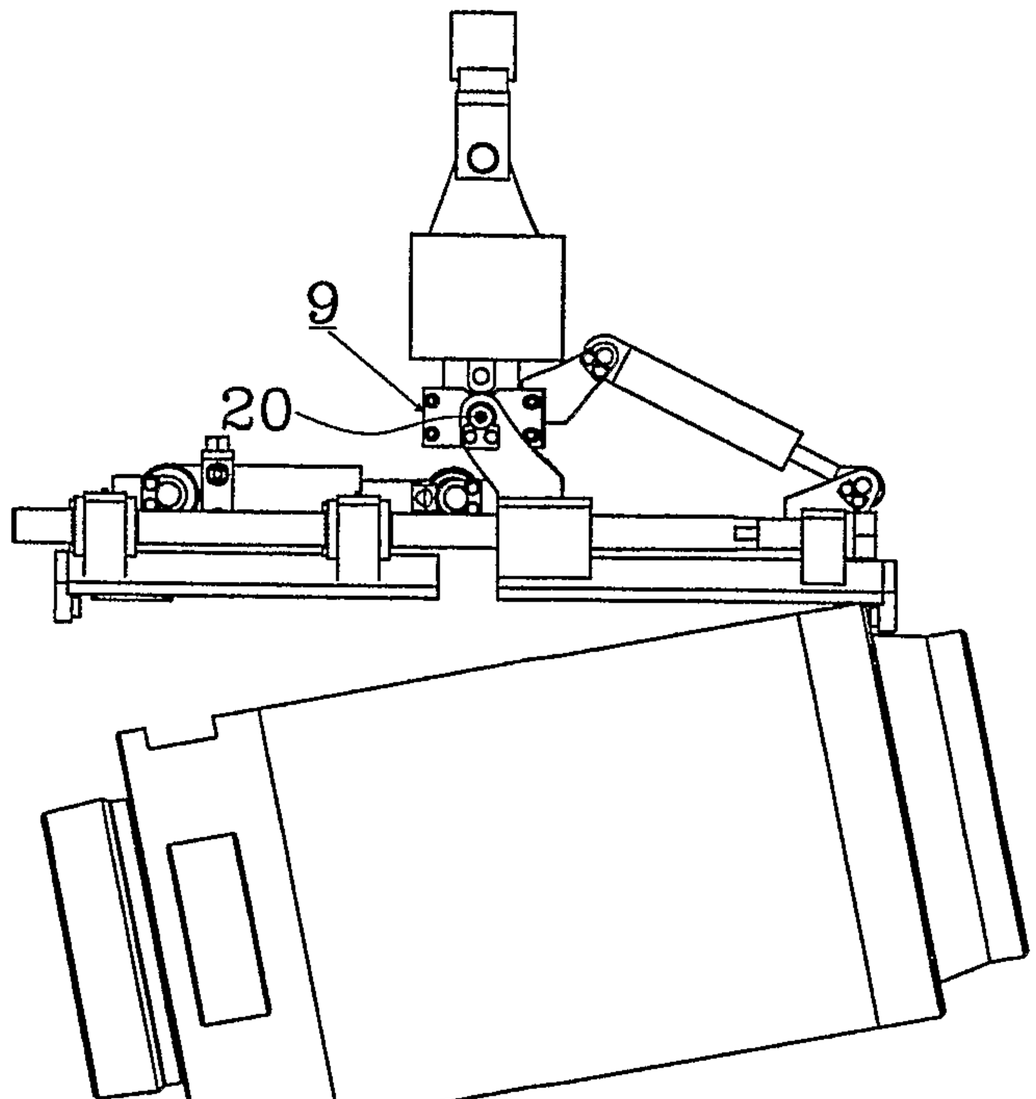


Fig. 5b

