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(54) **COMPACT ARTICULATED DRILLING MACHINE SUITABLE FOR OUTDOOR DRILLING OPERATIONS, BUT ALSO AND MORE SPECIFICALLY FOR EXCAVATION AND PERFORATION IN SMALL SPACES, GALLERIES AND/OR PASSAGES**

(57) The invention is an articulated drilling machine (1) comprising a vehicle (11) able to move in at least one advance direction (X), a drilling member (2) and an assembly (8) suited to constrain and manoeuvre said drilling member (2) with respect to said vehicle (11). Said constraint and manoeuvre assembly (8) comprises a first

horizontal slewing bearing (3) rotating around a vertical axis (Z), wherein said first slewing bearing (3) is in turn constrained to said vehicle (11) by means of at least one parallelogram kinematic mechanism (5) which enables the height of said first slewing bearing (3) to be varied between a minimum and a maximum height.

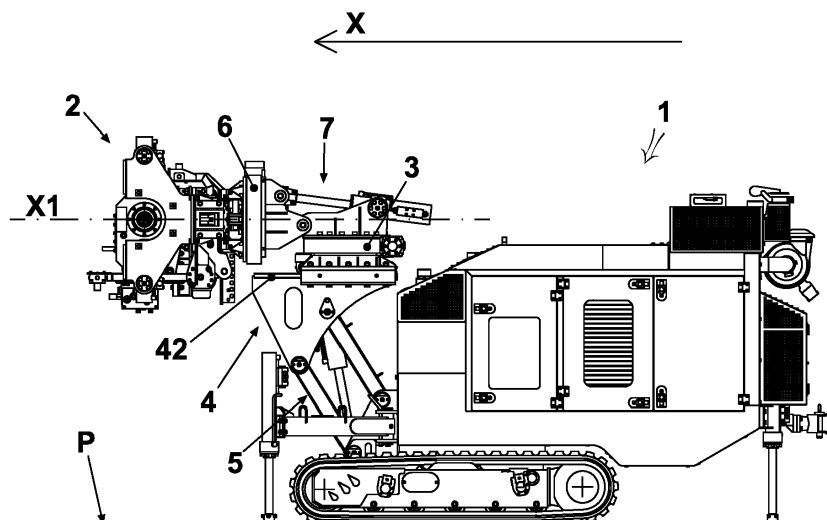


Fig. 6

Description

[0001] The present patent relates to drilling machines, and more specifically it concerns a new articulated drilling machine for drilling in open environments, particularly including excavations and drilling in narrow spaces, tunnels and/or culverts.

[0002] Drilling and bolting machines suitable for drilling in open environments and in confined spaces, underground works, tunnels, or mines are known in the art.

[0003] The prior art comprises self-propelled drilling machines, that is, machines comprising a vehicle on which the working members are mounted.

[0004] Drilling machines comprising a vehicle equipped with a frame, a self-propelled chassis, and a drilling member are known in the art. Said drilling member is supported by a kinematic mechanism generally consisting of at least one slewing bearing usually positioned horizontally and able to rotate around a vertical axis.

[0005] Drilling machines provided with a double slewing bearing are also known in the art, wherein the first slewing bearing is mounted horizontally on the vehicle frame and able to rotate around a vertical axis, while the second slewing bearing is constrained to said first slewing bearing with a kinematic mechanism which enables the second slewing bearing to be tilted with respect to the first slewing bearing.

[0006] In this case, said drilling member is constrained to said second slewing bearing, which, rotating around its own axis, rotates the mast, tilting it in different positions.

[0007] Therefore, the rotation of the first slewing bearing allows the mast to be moved to the right or to the left with respect to the vehicle; the inclination of the second slewing bearing with respect to the first slewing bearing tilts the mast with respect to the vertical direction, while the rotation of the second slewing bearing rotates the mast on the plane of the second slewing bearing itself.

[0008] A disadvantage of the drilling machines of this type is the fact that they do not allow other movements of the drilling member, unless complex kinematic mechanisms are integrated between the first and the second slewing bearing or between the second slewing bearing and the drilling member.

[0009] The object of the present patent is a new articulated drilling machine suited to be used for drilling operations in open environments, but also and particularly for excavations and drilling operations in narrow spaces, tunnels and passages.

[0010] The new articulated drilling machine comprises:

- a self-propelled vehicle suited to move in at least one advance direction, for example comprising a frame and a carriage preferably equipped with tracks;
- at least one drilling member, for example and preferably mounted on the front part of the vehicle, with respect to the advance direction, said drilling member in turn comprising a drilling head translating on

a corresponding guide or mast;

- an assembly suited to constrain said drilling member to said vehicle and to manoeuvre said drilling member,

and wherein said constraint and manoeuvre assembly comprises:

- at least one first slewing bearing, positioned on a horizontal plane, that is, parallel to the vehicle support plane, and able to rotate around a vertical axis, that is, orthogonal to said vehicle support plane,

and wherein said first slewing bearing is mounted on a support which is in turn constrained to said vehicle by means of at least one parallelogram kinematic mechanism which allows the height of said first slewing bearing to be varied between a fully lowered position and a fully raised position, preferably maintaining said first slewing bearing horizontal or substantially horizontal.

[0011] Said support preferably comprises also a substantially horizontal guide having a direction preferably parallel to the advance direction of the machine, wherein said first slewing bearing translates on said guide between a position of minimum distance from said vehicle and a position of maximum distance from said vehicle.

[0012] Said drilling member constraint and manoeuvre assembly also comprises at least one second slewing bearing, to which said drilling member is constrained, and wherein said second slewing bearing is constrained to said first slewing bearing by means of kinematic mechanisms allowing said second slewing bearing to be tilted in different positions with respect to said first slewing bearing.

[0013] Said drilling member can thus perform the following movements, individually or in combination with other movements:

1. rotational movement around a vertical axis, for example, at an angle at least included between +90° and -90° to the right and to the left with respect to the vehicle, wherein said movement is achieved through the rotation of said first slewing bearing;
2. rotational movement around a horizontal axis, such as to vary the inclination of said drilling member with respect to a plane orthogonal to the ground at least between an angle of 0°, where the mast is substantially vertical, and an angle of 90°, where the mast is substantially horizontal, and up to any subvertical position, where said movement is achieved by varying the inclination of said second slewing bearing with respect to said first slewing bearing;
3. rotational movement around an axis orthogonal to the plane of the second slewing bearing, such as to vary the inclination of said drilling member relative to the horizontal plane, to the right and to the left with respect to the vehicle, for example by an angle at least between +90° and -90°, and wherein said

movement is obtained through the rotation of said second slewing bearing.

[0014] In addition, said drilling head of the drilling member can translate along the aforementioned guide with respect to the second slewing bearing, as the drilling progresses.

[0015] In the new machine, said drilling member can also perform the following movement, individually or in combination with other movements:

4. forward/backward movement: to vary the distance of said drilling member from said vehicle. This movement occurs by means of the translation of said first slewing bearing, and consequently of the entire constraint and manoeuvre assembly on said horizontal guide. Once said drilling member is oriented in any drilling direction, it is then possible, without moving the machine either forward or backward, to translate the drilling member in order to perform additional parallel drilling, closer to or further away from the vehicle.

[0016] Thanks to the innovative parallelogram kinematic mechanism, the new machine can also carry out the following movement of the drilling member, independently or in combination with other movements:

5. lifting/lowering movement: to vary the height of said drilling member with respect to the vehicle support plane. This movement occurs by means of the rotation of said parallelogram kinematic mechanism, while extended or contracted. Once said drilling member is oriented in any drilling direction, it is then possible to perform additional parallel drilling at different heights.

[0017] Moreover, when said parallelogram kinematic mechanism is in a completely folded position, it is in an extremely compact configuration, making the new machine particularly usable even in very restricted spaces.

[0018] The characteristics of the new machine will be better explained in the following description with reference to the drawings, which are attached hereto by way of a non-limiting example.

Figure 1 shows a side view of the new machine (1) with a drilling assembly (2) positioned vertically, completely lowered and in the position of minimum distance from the vehicle (11) of the machine (1).

Figure 2 shows a plan view of the new machine (1) in the position illustrated in Figure 1.

Figure 3 shows a side view of the new machine (1) illustrated in Figure 1 with the drilling assembly rotated by 90° to the left with respect to the vehicle (11).

Figure 4 shows a plan view of the new machine (1) in the position illustrated in Figure 3.

Figure 5 shows a side view of the new machine (1), where the parallelogram kinematic mechanism (5) is shown in the lowered position and the drilling assembly (2) rotated in the horizontal position, while Figure 6 shows a side view of the new machine (1) with the parallelogram kinematic mechanism (5) in its raised position.

Figure 6a shows, in a detail of Figure 6, the constraint and manoeuvre assembly (8).

Figure 7a shows a three-dimensional view of a detail of the constraint and manoeuvre assembly (8) in the lowered position, while in Figure 7b it is shown in its raised position.

Figure 8 shows a front view of the new machine (1) in the position shown in Figures 5 and 6, with the drilling member (8) rotated in the horizontal position, orthogonal to the advance direction (X).

[0019] The new articulated and compact drilling machine (1) comprises a self-propelled vehicle (11), for example comprising a frame (12) and a carriage (13) preferably equipped with tracks (14), configured so that the machine (1) can move in at least one advance direction (X).

[0020] The articulated drilling machine (1) also comprises at least one drilling member (2), for example mounted on the front part (121) of the frame (12), with respect to the advance direction (X).

[0021] Said drilling member (2) in turn comprises at least one mast or guide (22) and at least one drilling head (21) translating on said guide (22).

[0022] Said drilling member (2) is mounted on said frame (12) of the vehicle (1) by means of at least one first slewing bearing (3) positioned on a horizontal plane, that is, parallel to the support plane (P) of the vehicle (11), and rotating around a vertical axis (Z), that is, orthogonal to said support plane (P).

[0023] Said first slewing bearing (3) is mounted on a support (4) that is visible in detail in Figures 6a, 7a and 7b.

[0024] Said support (4) comprises a base (41) that is integral with said first slewing bearing (3) and a guide (42) on which said base (41) translates together with said first slewing bearing (3).

[0025] Said guide (42) is constrained to said frame (12) of the vehicle (11) by means of one or more brackets (43) and at least one parallelogram kinematic mechanism (5) configured so as to make it possible to vary the height of said first slewing bearing (3) between a fully lowered position, for example shown in Figures 1, 5 and 7a, and a fully raised position, for example shown in Figures 6, 6a and 7b, preferably keeping it horizontal or substantially horizontal.

[0026] Said parallelogram kinematic mechanism (5), for example, comprises at least two parallel rods/bars (51) hinged to said frame (12) and to said brackets (43) of the support (4) by means of at least two pairs of hinges (52, 53) which enable the rotation in a horizontal direction (Y), orthogonal to said advance direction (X).

[0027] The movement of said parallelogram kinematic mechanism (5) is conveniently controlled by fluid-dynamic or pneumatic means (54).

[0028] Said guide (42) for the translation of said base (41) of the support (4) and of said first slewing bearing (3) is therefore preferably kept horizontal and is also preferably oriented so that it is parallel to the advance direc-

tion (X).

[0029] Said first slewing bearing (3) can therefore translate between a backward position, at the minimum distance from said vehicle (11), and a forward position, at the maximum distance from said vehicle (11).

[0030] Said drilling member (2) is furthermore constrained to said frame (12) by means of at least one second slewing bearing (6), in turn constrained to said first slewing bearing (3) by means of kinematic mechanisms (7) which make it possible to tilt said second slewing bearing (6) in different positions with respect to said first slewing bearing (3).

[0031] Said drilling member (2), for example, is constrained to said second slewing bearing (6) so that said mast (22) is substantially parallel to the plane of the second slewing bearing (6).

[0032] Said second slewing bearing (6) allows said drilling member (2) to be rotated around its own axis of rotation (X1), which can therefore be oriented in different ways, both with respect to the support plane (P) and with respect to a plane that is vertical or orthogonal to the support plane (P).

[0033] In a possible preferred embodiment, said kinematic mechanisms (7) comprise at least one hinge (71) suited to constrain said second slewing bearing (6) to said first slewing bearing (3), which enables the rotation of said second slewing bearing (6) in a horizontal direction (Y1) parallel to the support plane of said first slewing bearing (3).

[0034] In the example of Figure 7a, said direction (Y1) is parallel to said direction (Y) of rotation of the parallelogram kinematic mechanism (5), that is, it has a horizontal direction and is orthogonal to said advance direction (X).

[0035] Said kinematic mechanisms (7) preferably comprise also fluid-dynamic or pneumatic means (72) suited to control the aforementioned rotation.

[0036] Thus, said kinematic mechanisms (7) make it possible to position said second slewing bearing (6) on a vertical plane, that is, orthogonal to the support plane (P), and to selectively tilt it with respect to said vertical plane.

[0037] For example, it is possible to rotate said second slewing bearing (6) backwards towards the vehicle (12) by an angle, for example up to 90° with respect to the vertical plane, positioning said second slewing bearing (6) and therefore said mast (22) substantially horizontal, or forward, for example up to an angle of -10° with respect to the vertical or even beyond.

[0038] Said drilling member (2) can therefore perform the following movements, independently or in combination with other movements:

1. rotational movement of said first slewing bearing (3) around said vertical axis (Z), for example by an angle ranging from +90° to -90°;
2. rotational movement of said hinges (71) of the kinematic mechanism of said second slewing bear-

ing (6) around said horizontal axis of rotation (Y1), for example between -10° and +90° with respect to the vertical;

3. rotational movement of said second slewing bearing (6) around said axis (X1), for example by an angle of +90° and -90°;

4. forward/backward movement of said first slewing bearing (3) on said guide (42) of said support (4) to vary the distance of said drilling member (2) from said vehicle (11); once said drilling member (2) is oriented in any drilling direction, it is then possible, without moving the vehicle (11) forward or backward, to translate said first slewing bearing (3) and therefore said drilling member (2) to carry out other parallel drillings, closer to or further away from the vehicle (11);

5. lifting/lowering movement of said first slewing bearing (3) by moving said parallelogram kinematic mechanism (5) to consequently change the height of said drilling member (2) with respect to the support plane (P) of the vehicle (11); once said drilling member (2) is oriented in any drilling direction, it is then possible to carry out other parallel drillings at different heights.

[0039] These are the schematic outlines that are sufficient for the expert in the art to carry out the invention; as a result, in the practical application variants may be carried out without prejudice to the innovative substance of the concept introduced herewith.

[0040] Therefore, with reference to the preceding description and the attached drawings, the following claims are expressed.

Claims

1. Articulated drilling machine (1) comprising a vehicle (11) able to move in at least one advance direction (X), at least one drilling member (2) mounted on said vehicle (11) and an assembly (8) suited to constrain and manoeuvre said drilling member (2) with respect to said vehicle (11), **characterized in that** said constraint and manoeuvre assembly (8) comprises at least one first slewing bearing (3) positioned on a horizontal plane, that is, parallel to the support plane (P) of said vehicle (11), and rotating around at least one vertical axis (Z), that is, orthogonal to said support plane (P), and wherein said first slewing bearing (3) is mounted on a support (4) that in turn is constrained to said vehicle (11) by means of at least one parallelogram kinematic mechanism (5) which allows the position of said first slewing bearing (3) to be varied between a minimum and a maximum height with respect to the support plane (P).
2. Articulated drilling machine (1) according to claim 1, **characterized in that** said parallelogram kinematic

mechanism (5) comprises at least two parallel rods/bars (51) hinged to said vehicle (11) and to said support (4) of said first slewing bearing (3) by means of at least two pairs of hinges (52, 53) which rotate in the horizontal direction (Y), orthogonal to said advance direction (X), so as to keep said first slewing bearing (3) in a substantially horizontal position.

3. Articulated drilling machine (1) according to claims 1 or 2, **characterized in that** it comprises fluid-dynamic or pneumatic means (54) suited to control the movement of said parallelogram kinematic mechanism (5).
4. Articulated drilling machine (1) according to any of the preceding claims, **characterized in that** said support (4) of said first slewing bearing (3) comprises a base (41) integral with said first slewing bearing (3) and at least one guide (42) on which said base (41) translates together with said first slewing bearing (3).
5. Articulated drilling machine (1) according to claim 4, **characterized in that** said at least one guide (42) is substantially horizontal and has a direction that is parallel to said advance direction (X), such that said first slewing bearing (3) can translate on said guide (42) between a backward position at a minimum distance from said vehicle (11) and a forward position at a maximum distance from said vehicle (11).
6. Articulated drilling machine (1) according to any of the preceding claims, **characterized in that** said constraint and manoeuvre assembly (8) comprises also at least one second slewing bearing (6) rotating around its own axis (X1), said drilling member (2) being constrained to said second slewing bearing (6), and wherein said second slewing bearing (6) is constrained to said first slewing bearing (3) by means of kinematic mechanisms (7) which allow said second slewing bearing (6) to be tilted in various positions with respect to said first slewing bearing (3).
7. Articulated drilling machine (1) according to claim 6, **characterized in that** said drilling member (2) comprises at least one mast or guide (22) and at least one drilling head (21) translating on said mast (22), and wherein said mast (22) is constrained to said second slewing bearing (6) in a position substantially parallel to the plane of the second slewing bearing (6).
8. Articulated drilling machine (1) according to claim 6, **characterized in that** said kinematic mechanisms (7) comprise at least one hinge (71) suited to constrain said second slewing bearing (6) to said first slewing bearing (3) and suited to rotate in a direction (Y1) parallel to the plane on which said first slewing

bearing (3) lies, such that said kinematic mechanisms (7) make it possible to position said second slewing bearing (6) on a vertical plane, that is, orthogonal to the support plane (P), and to selectively tilt it with respect to said vertical plane.

9. Articulated drilling machine (1) according to claim 8, **characterized in that** said kinematic mechanisms (7) comprise fluid-dynamic or pneumatic means (72) suited to control said rotation.
10. Articulated drilling machine (1) according to claim 1, **characterized in that** said first slewing bearing (3) rotates around said vertical axis (Z) by an angle at least included between +90° and -90°.
11. Articulated drilling machine (1) according to claim 6 or 8, **characterized in that** said kinematic mechanism (7) of said second slewing bearing (6) rotates said second slewing bearing (6) between -10° and +90° with respect to a vertical plane, that is, orthogonal to said support plane (P).
12. Articulated drilling machine (1) according to claim 6, **characterized in that** said second slewing bearing (6) rotates around its own axis (X1) by an angle at least included between +90° and -90°.

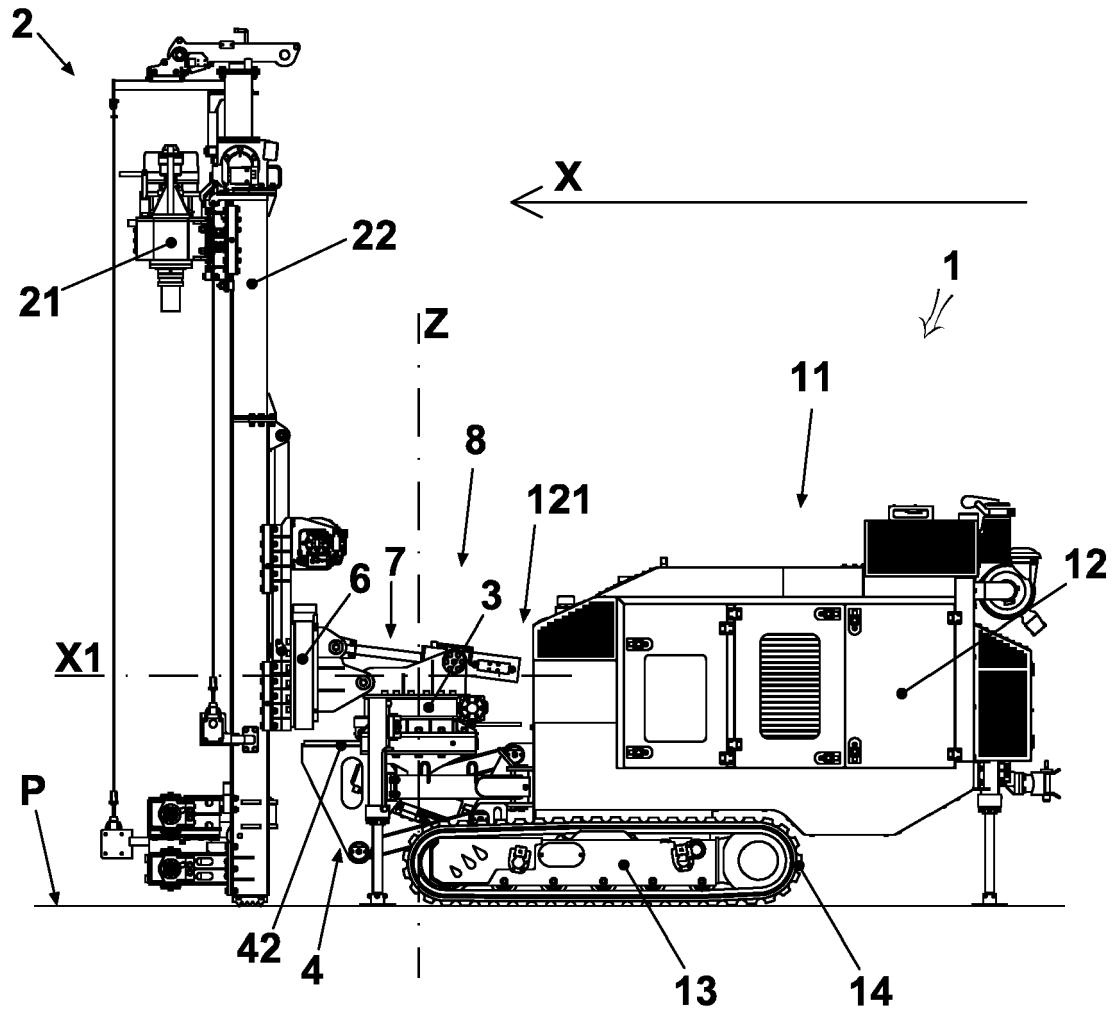


Fig. 1

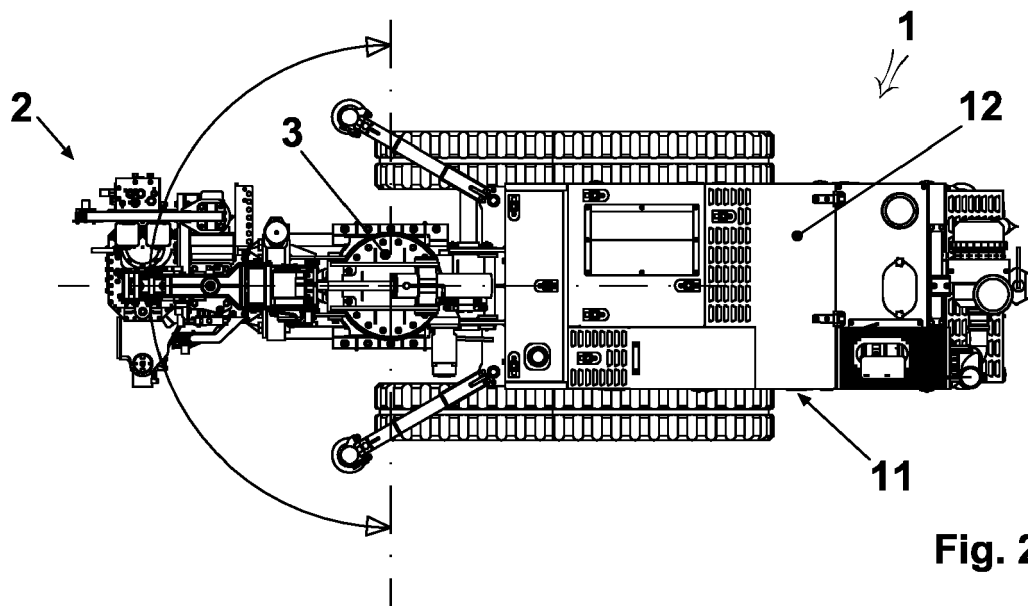


Fig. 2

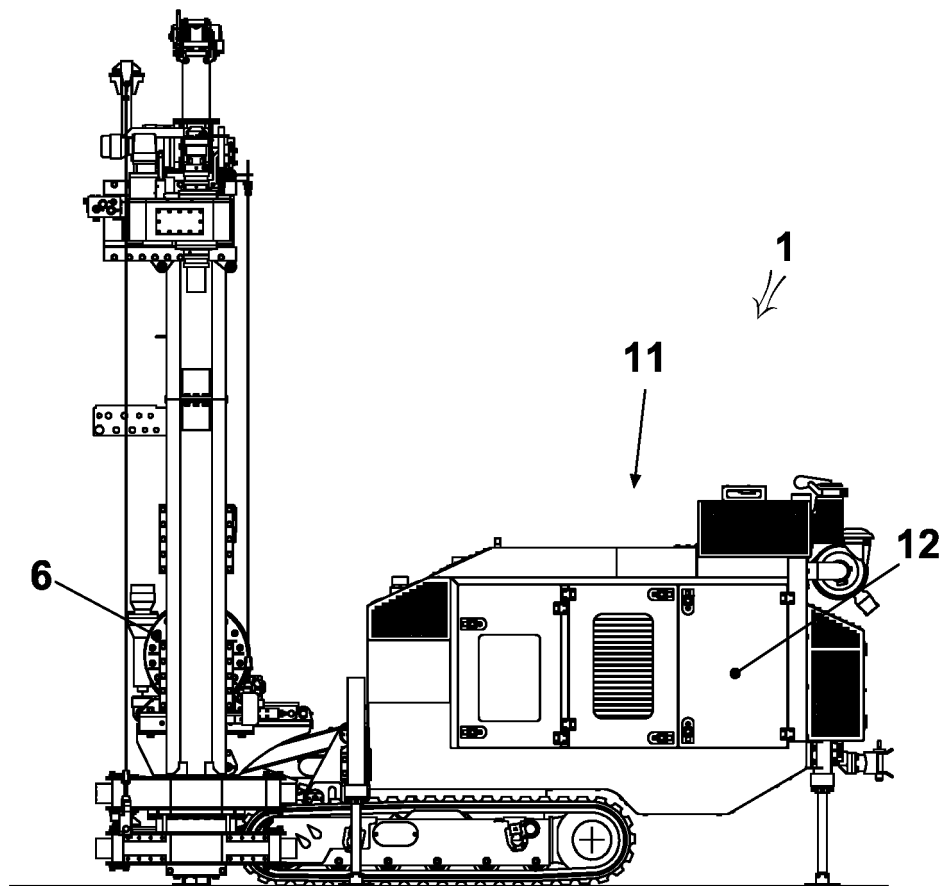


Fig. 3

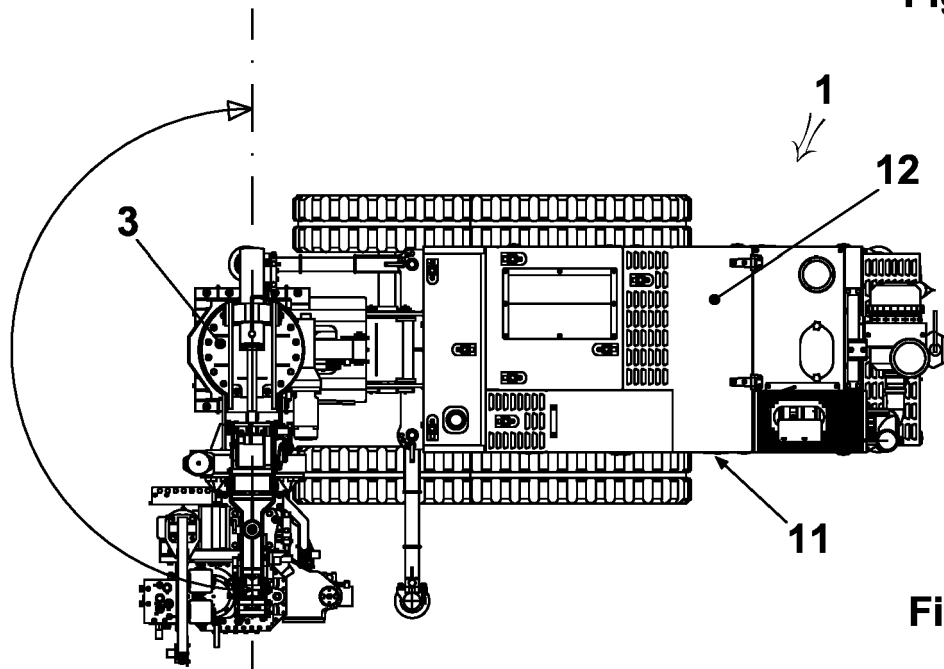


Fig. 4

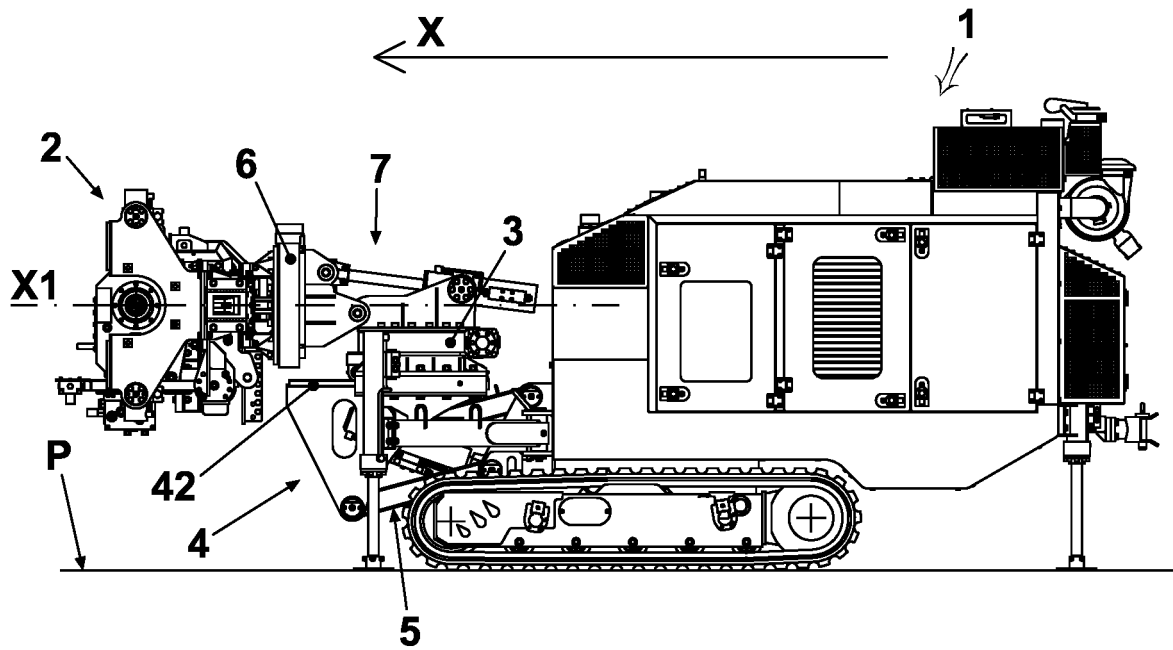


Fig. 5

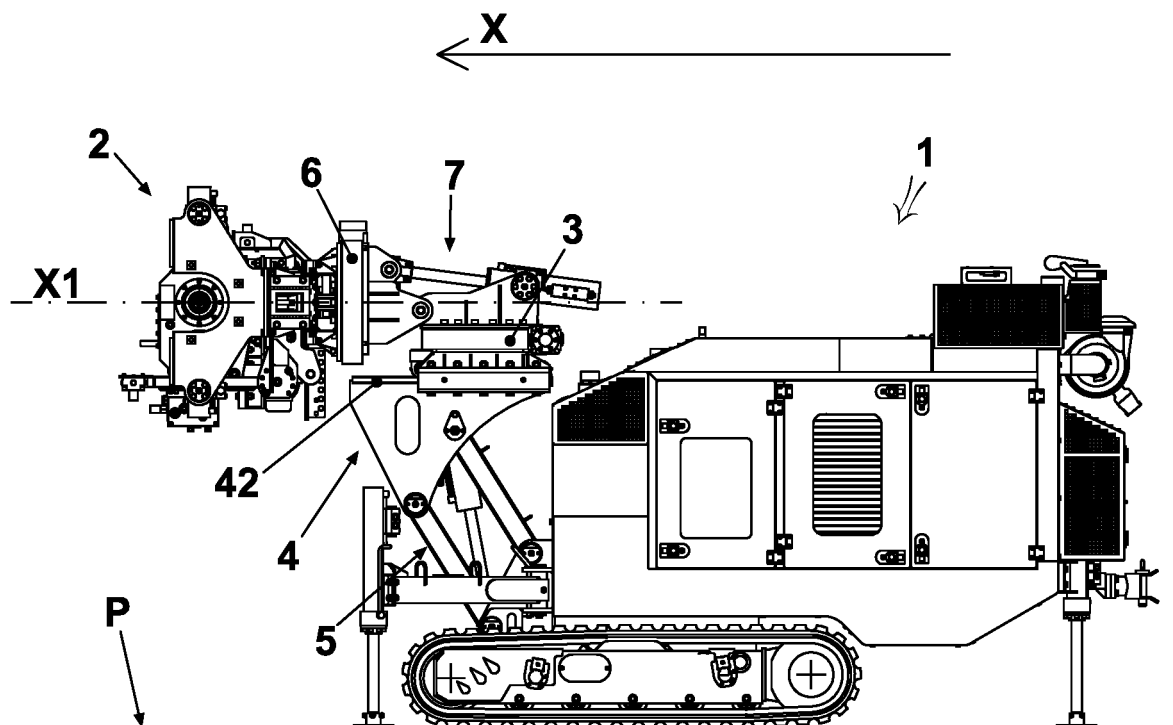
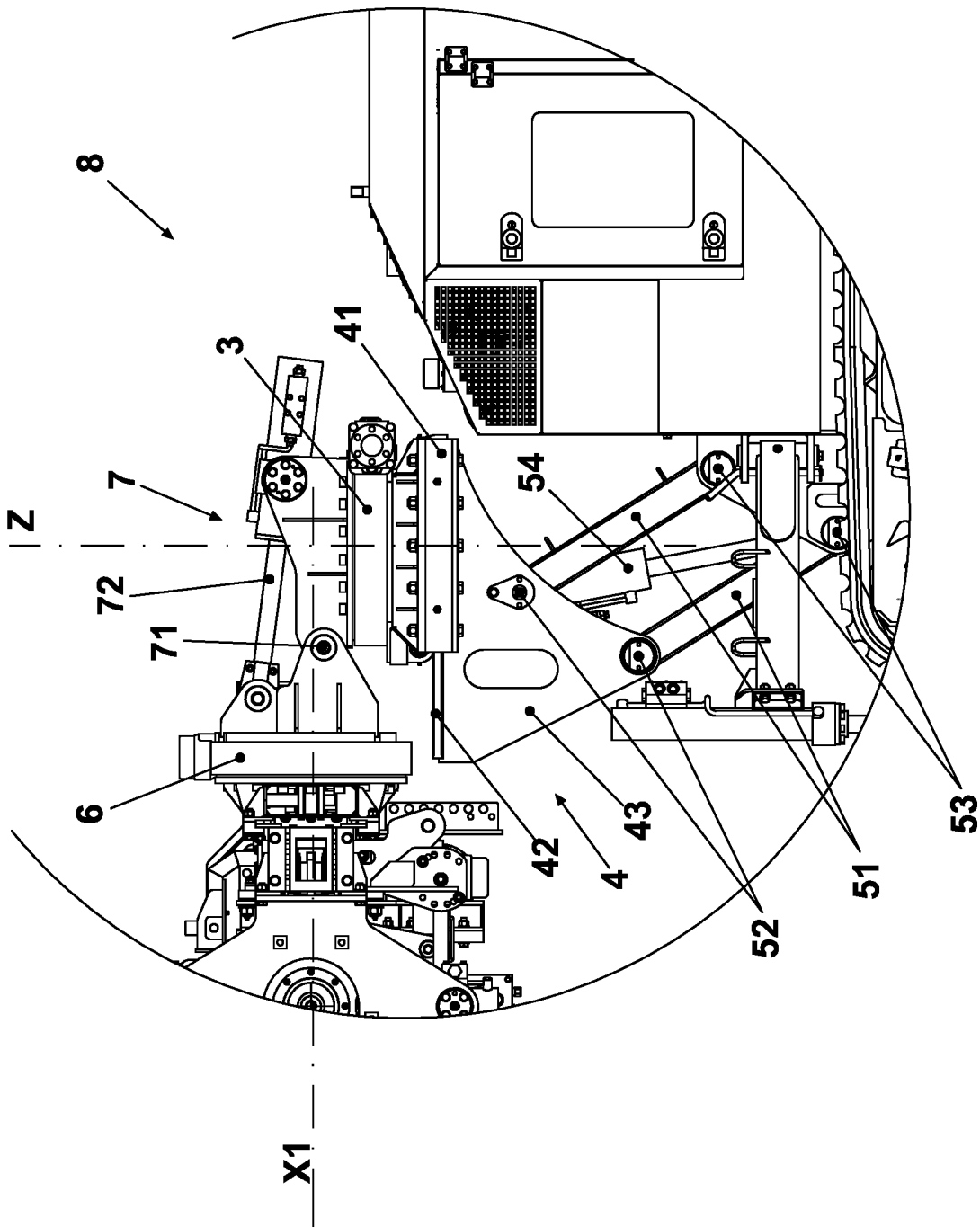
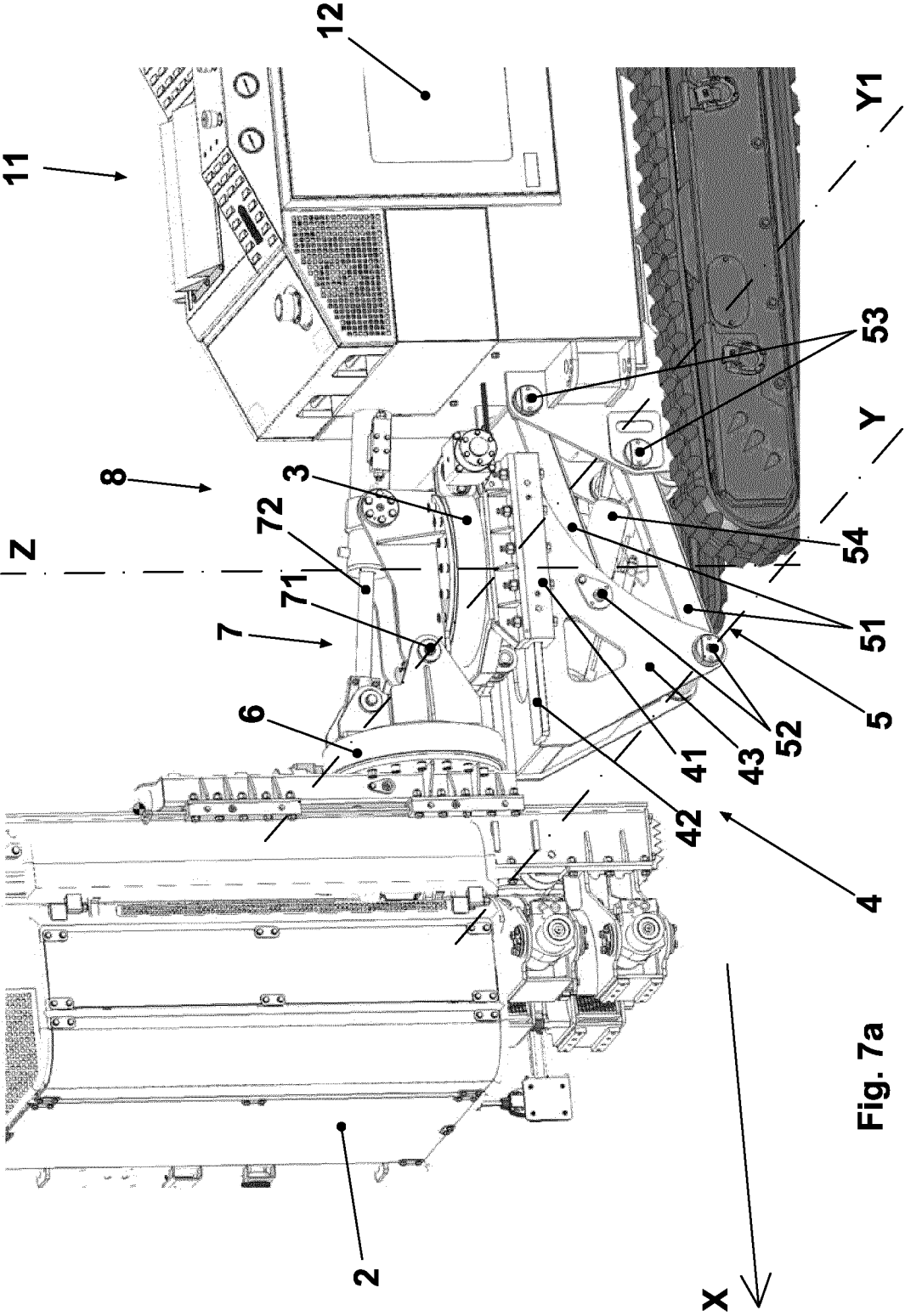


Fig. 6





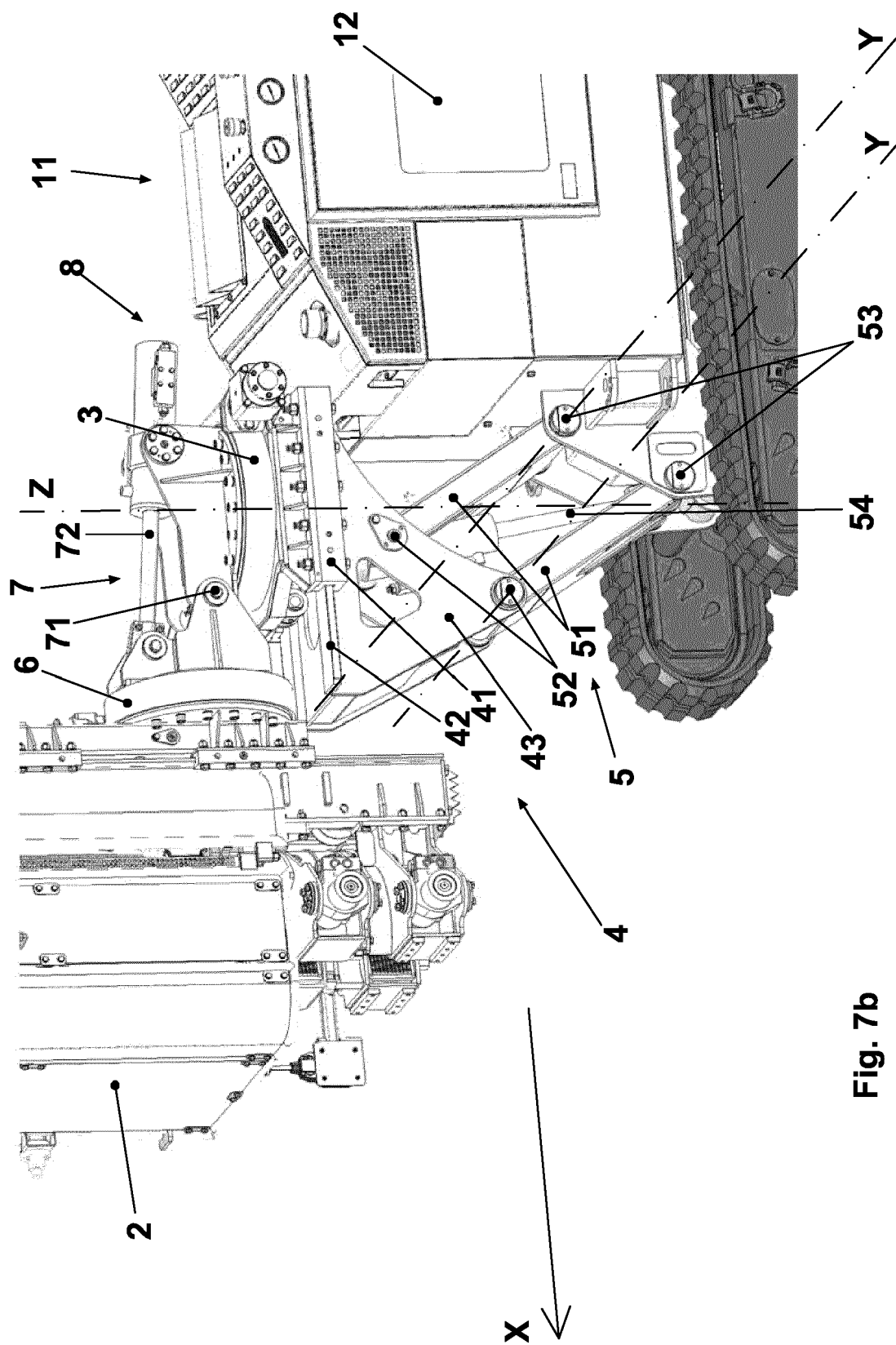


Fig. 7b

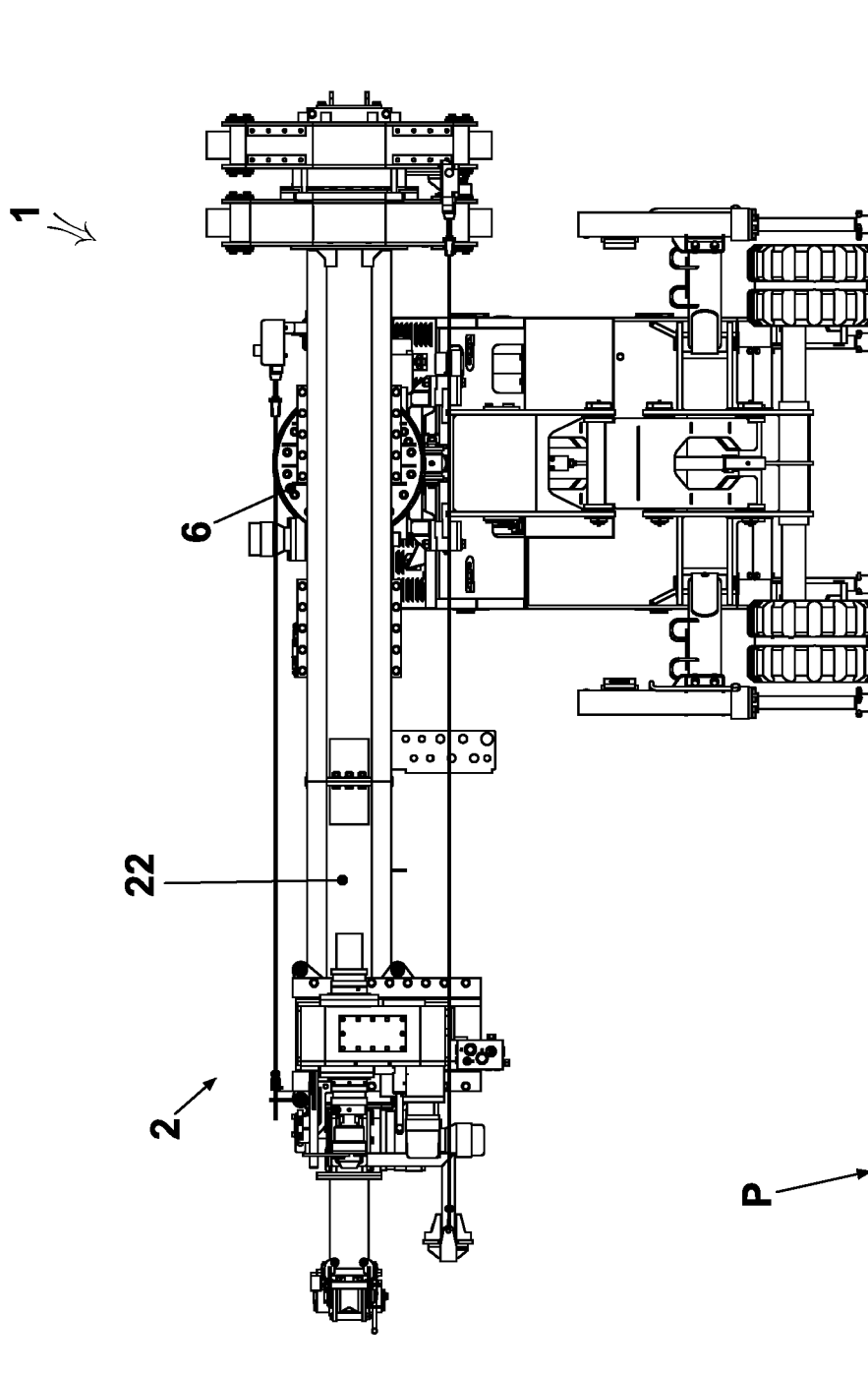


Fig. 8



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 Application Number
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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