



(19) **United States**

(12) **Patent Application Publication**
BINON et al.

(10) **Pub. No.: US 2024/0240426 A1**

(43) **Pub. Date: Jul. 18, 2024**

(54) **DRILLING MACHINE HAVING A GRAB-BUCKET CHASSIS PROVIDED WITH A QUICK-RELEASE MILLING DEVICE**

Publication Classification

(51) **Int. Cl.**
E02F 3/20 (2006.01)
E02F 3/22 (2006.01)
(52) **U.S. Cl.**
CPC *E02F 3/205* (2013.01); *E02F 3/22* (2013.01)

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(57) **ABSTRACT**

The invention relates to a drilling machine (10) including a grab frame (12) which comprises a body (16) extending along a longitudinal direction (L), a movable member (32), a first arm (34) pivotable relative to the movable member, a second arm (36) pivotable relative to the movable member (32), the second arm having a lower end part, at least one actuator device (37) connected to the body to move at least the first arm (34) relative to the body; The invention is characterized in that said drilling machine (10) includes a removable milling device (100) including a first dismountable securing device (120) for removably fixing the support (110) to the body (16), and a second dismountable securing device (150) for removably fixing the support (110) to the first arm, whereby the milling device can be easily dismounted from the frame.

(21) Appl. No.: **18/557,712**

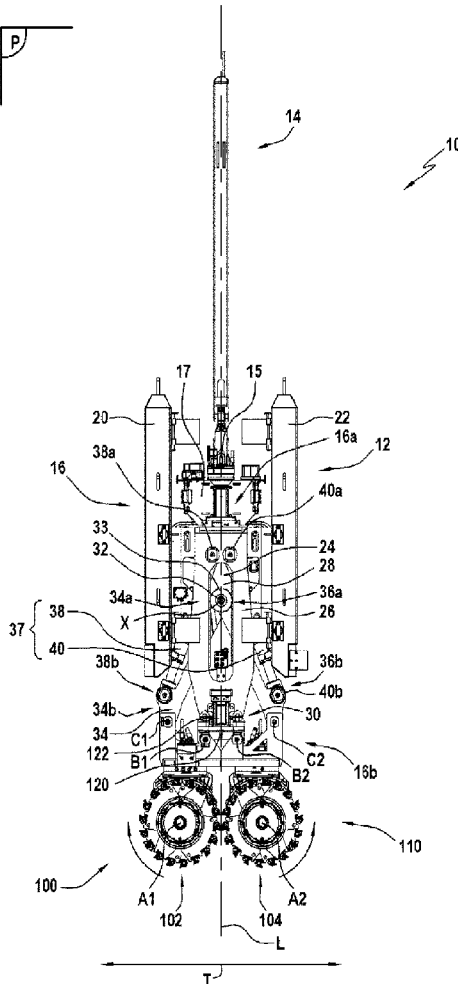
(22) PCT Filed: **Apr. 20, 2022**

(86) PCT No.: **PCT/EP2022/060453**

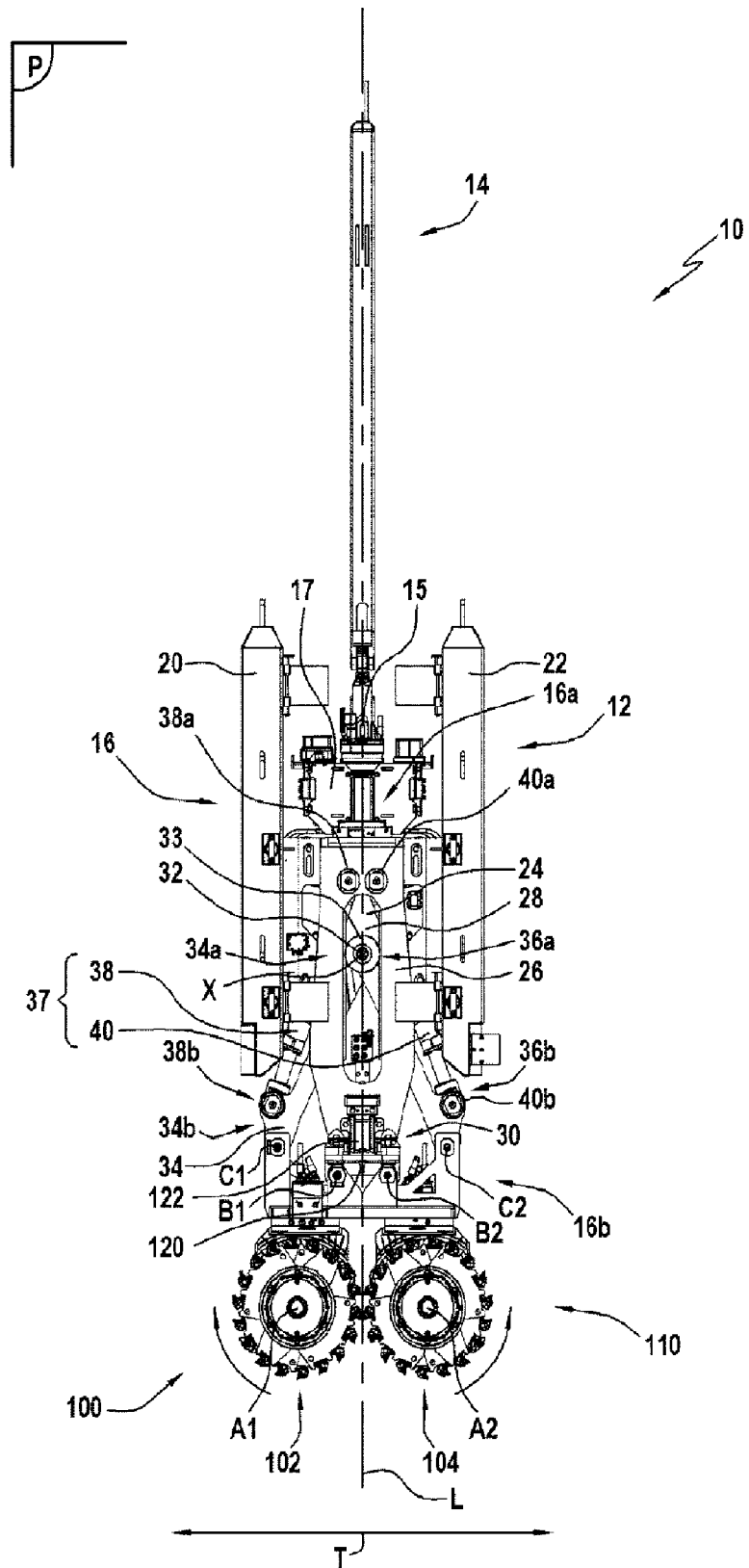
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(2) Date: **Oct. 27, 2023**

(30) **Foreign Application Priority Data**

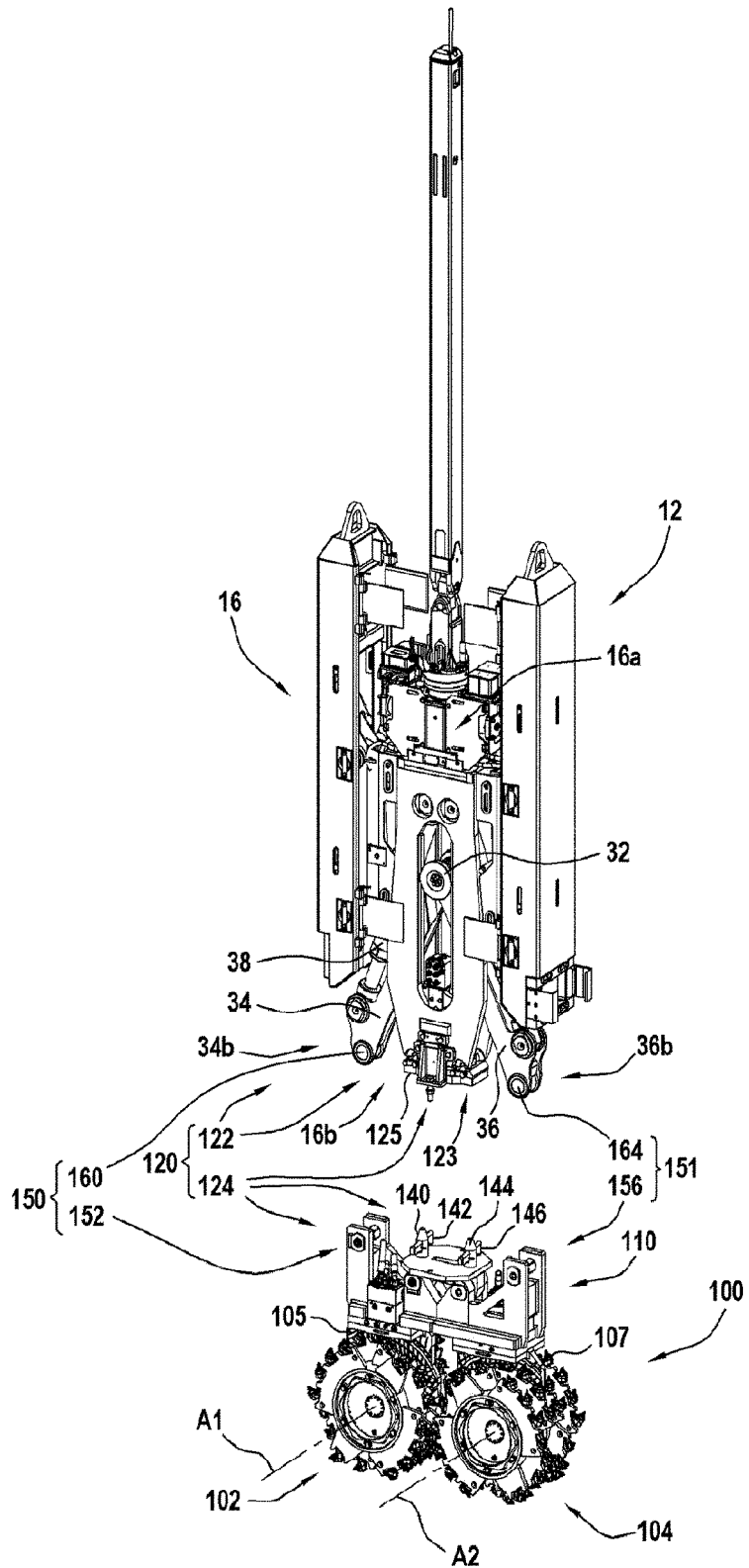
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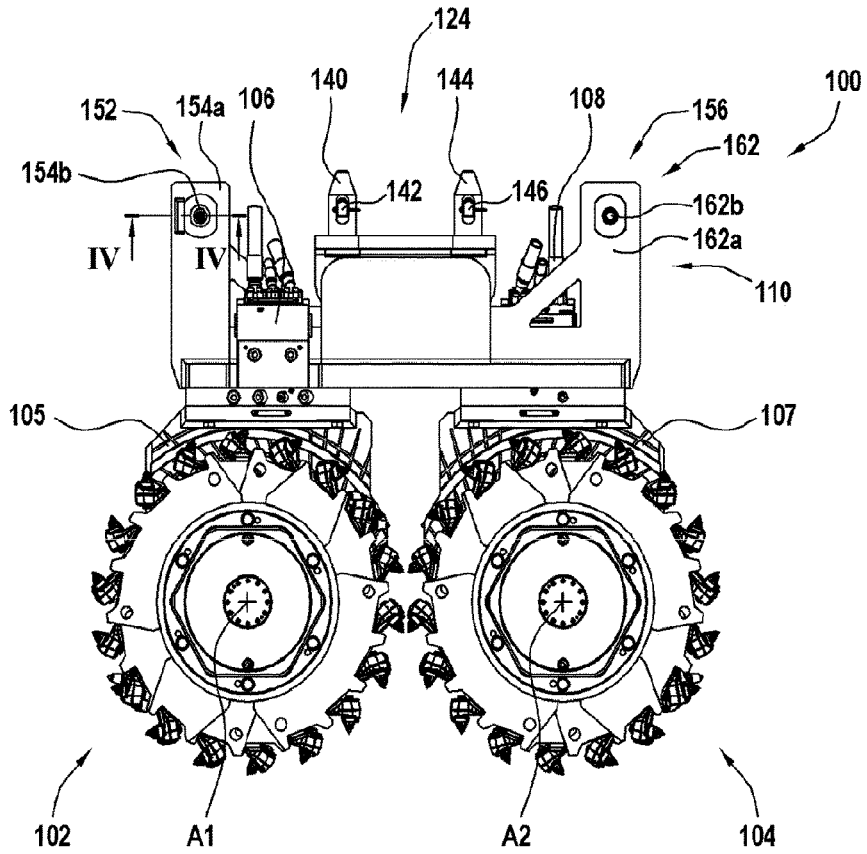
[Fig. 1]



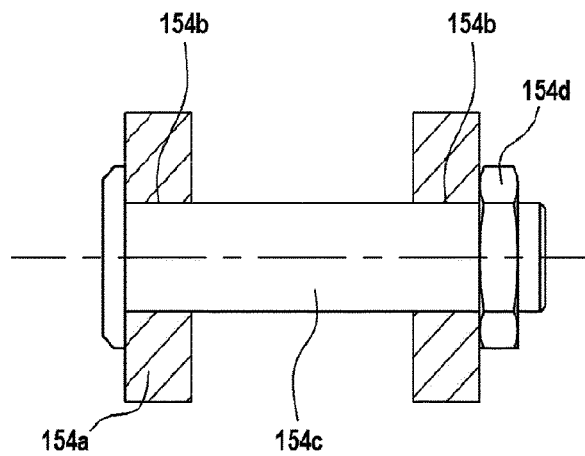
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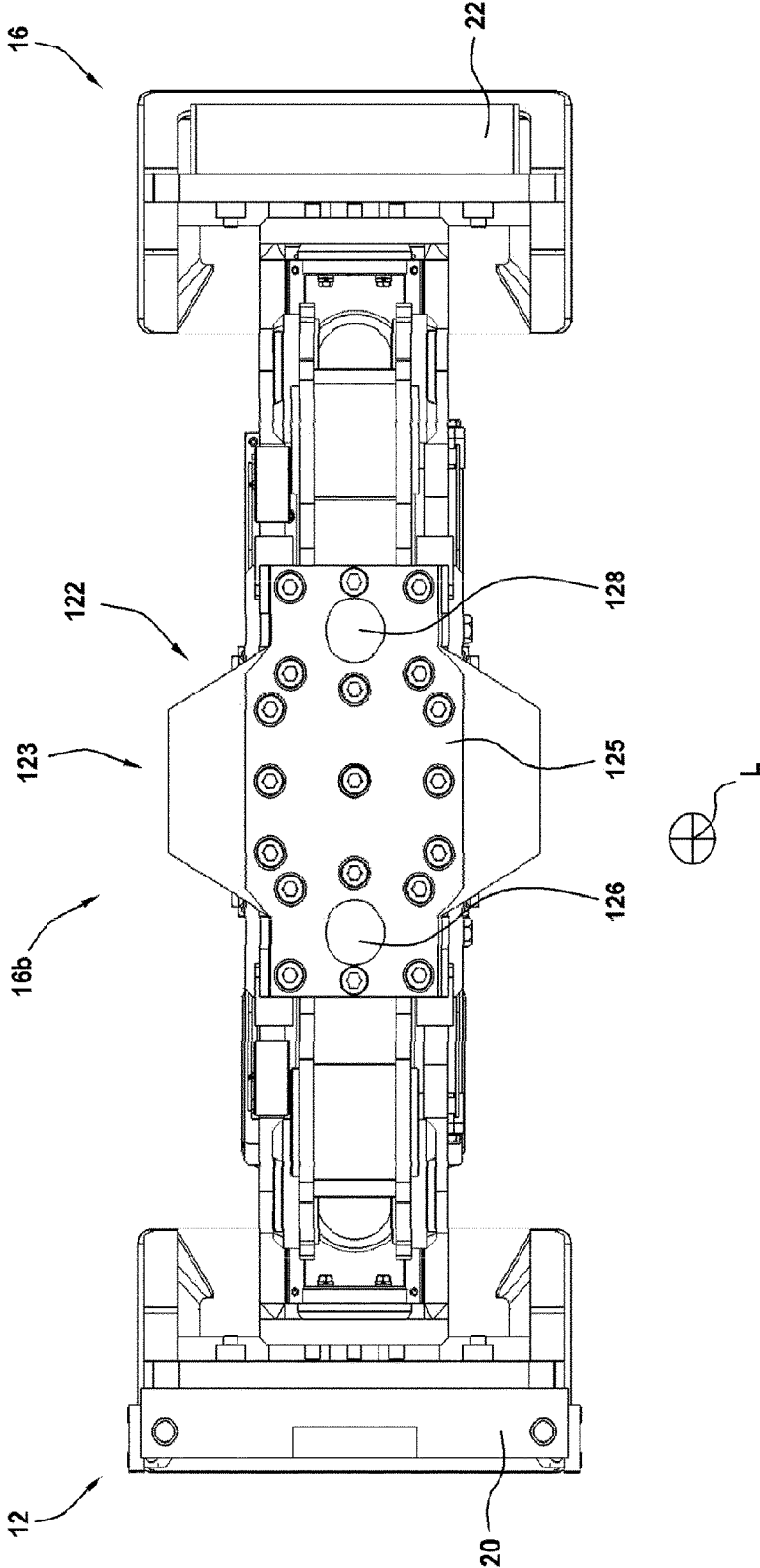
[Fig. 3]



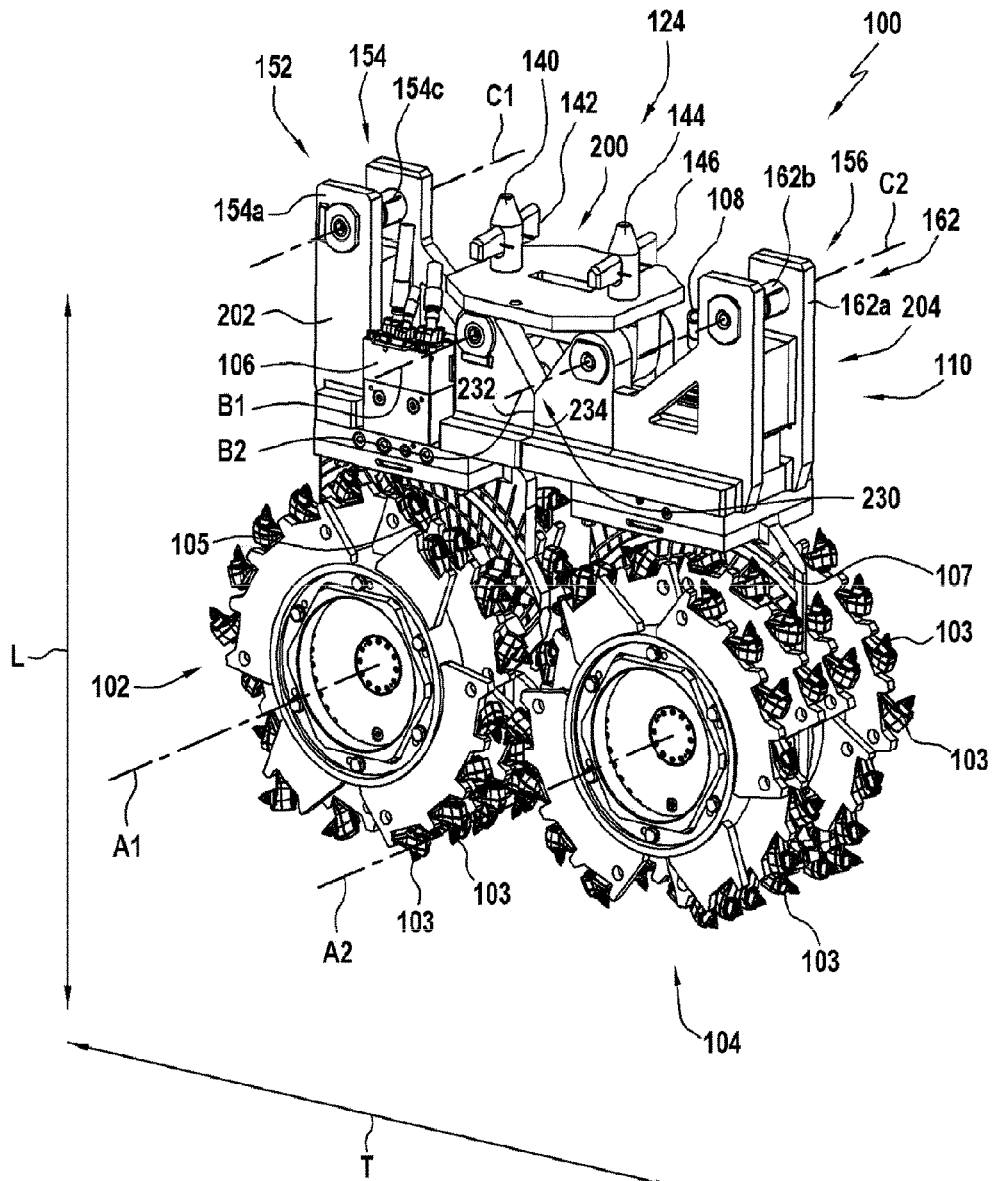
[Fig. 4]



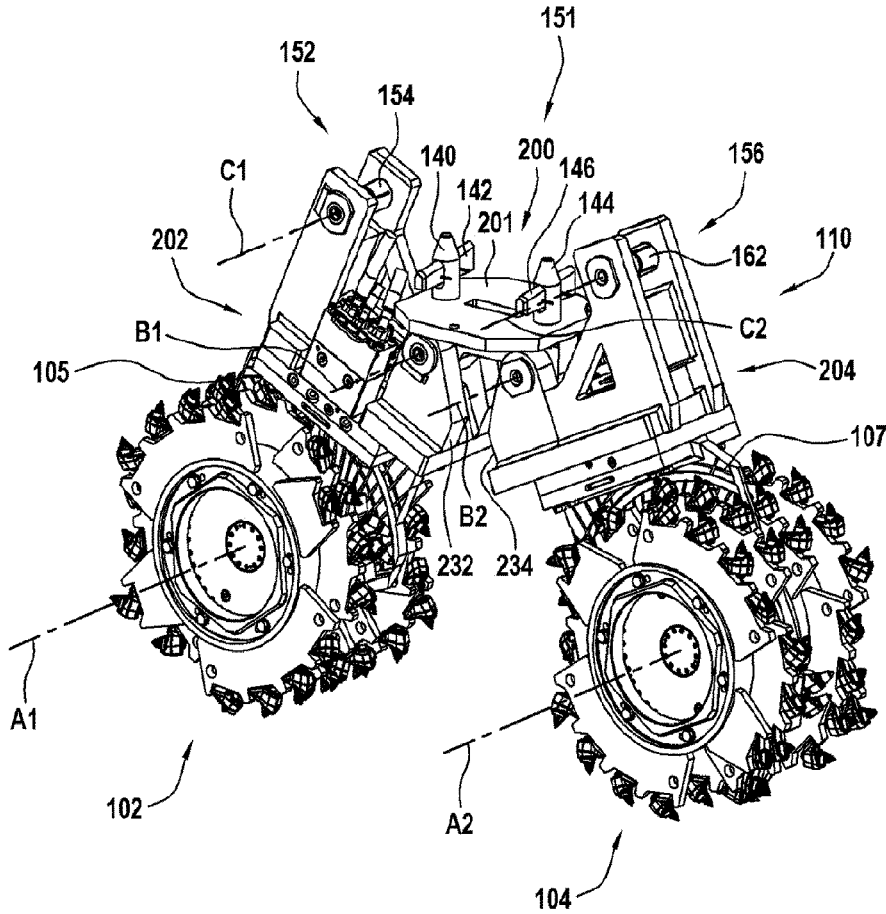
[Fig. 5]



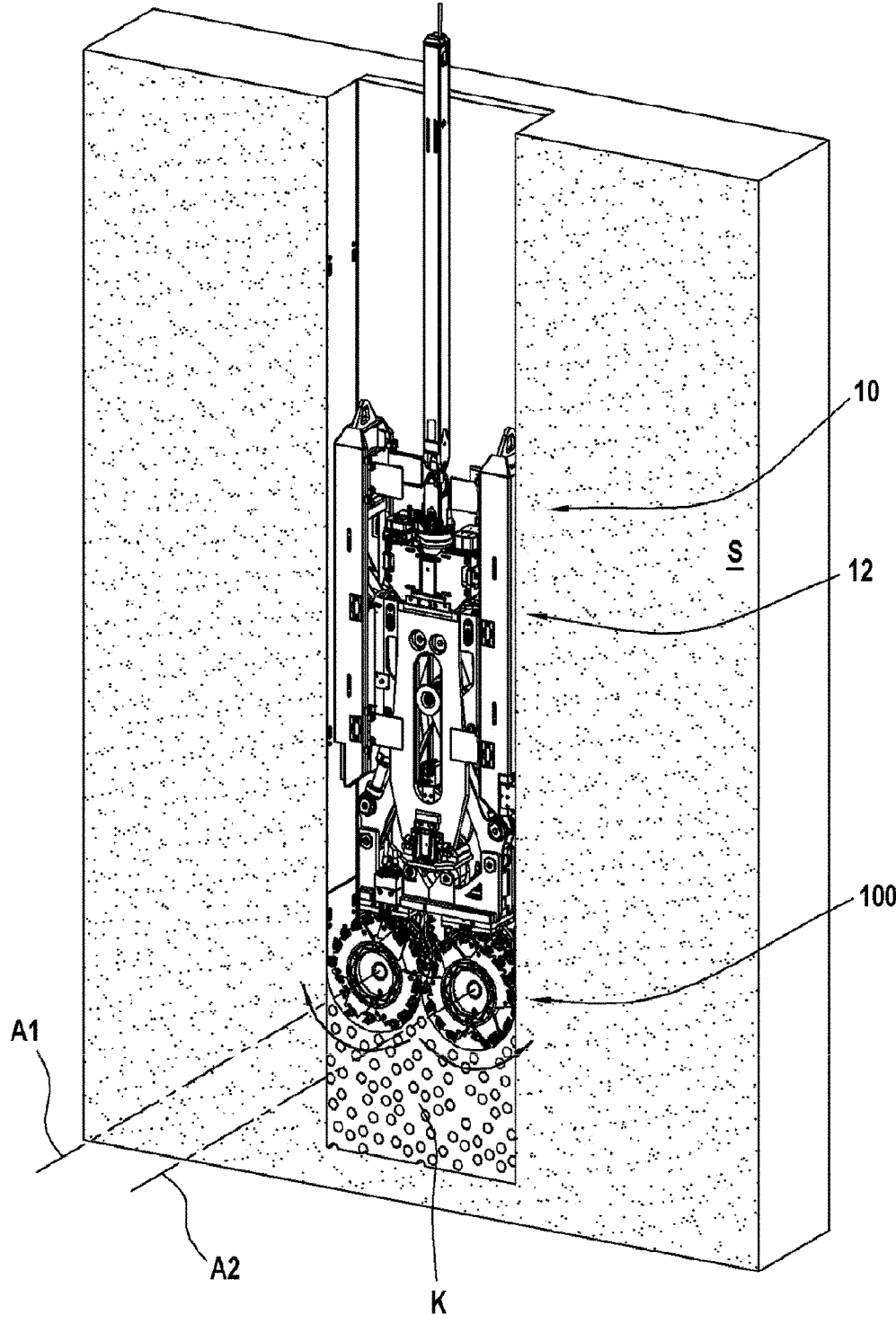
[Fig. 6]



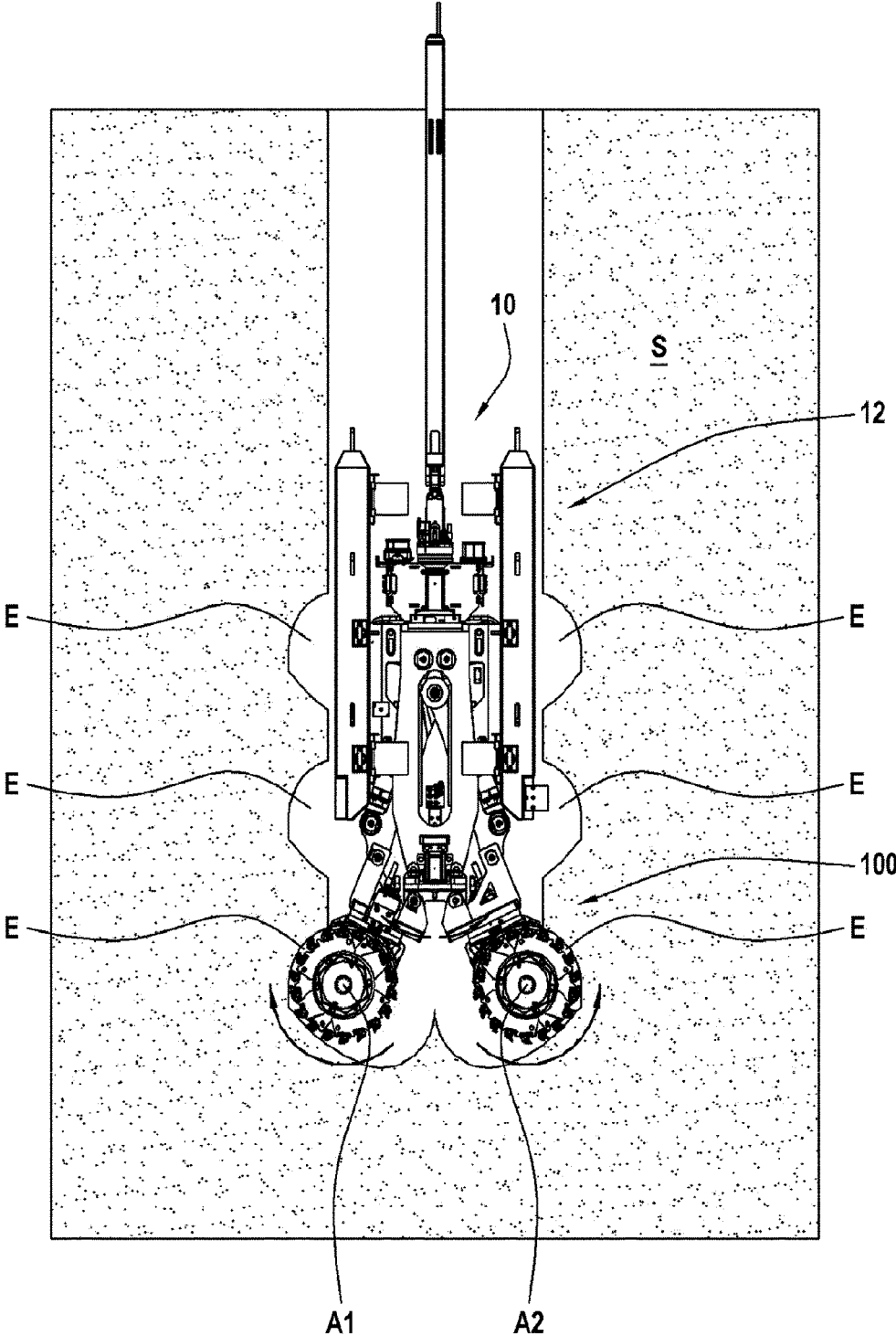
[Fig. 7]



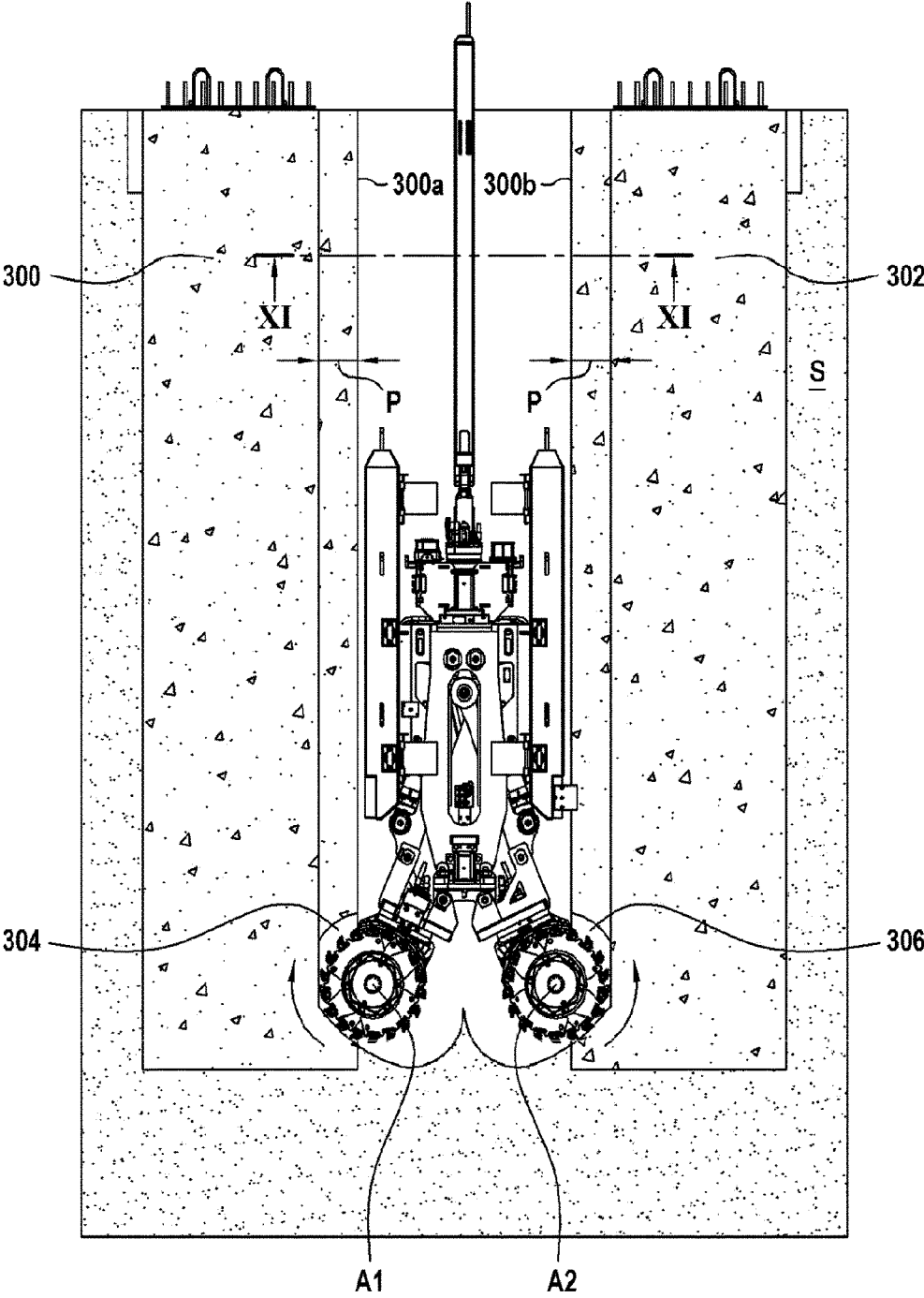
[Fig. 8]



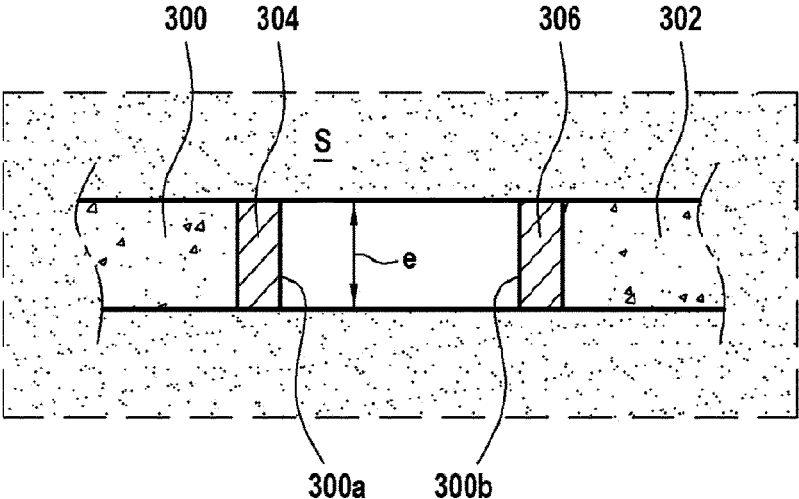
[Fig. 9]



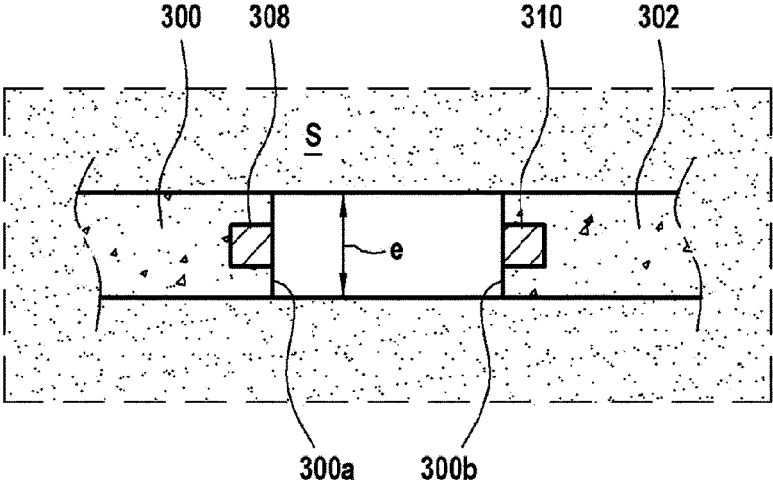
[Fig. 10]



[Fig. 11]



[Fig. 12]



**DRILLING MACHINE HAVING A
GRAB-BUCKET CHASSIS PROVIDED WITH
A QUICK-RELEASE MILLING DEVICE**

TECHNICAL FIELD

[0001] The present invention relates to the field of making excavations in the ground. It relates in particular to a drilling machine equipped with a milling device.

PRIOR ART

[0002] To make trenches in the ground, for example for the purpose of manufacturing diaphragm walls, several techniques are traditionally implemented. One of the known techniques consists of using a drilling tool called “diaphragm wall clamshell grab” which includes a grab frame at the lower end of which two buckets are mounted. The grab frame includes a mechanism to open and close the buckets. The actuation of the buckets can be achieved using hydraulic actuators. In this case, the drilling tool is generally called “hydraulic grab”.

[0003] Traditionally, a grab frame comprises:

[0004] a body extending along a longitudinal direction between an upper end part and a lower end part, the body having a translational guide device extending along the longitudinal direction,

[0005] a movable member cooperating with the guide device so that the movable member can be moved relative to the body along the longitudinal direction;

[0006] a first arm pivotable relative to the movable member, the first arm having a lower end part;

[0007] a second arm pivotable relative to the movable member, the second arm having a lower end part, the first and second arms being pivotable relative to each other,

[0008] at least one actuator device connected to the body to move at least the first arm relative to the body.

[0009] The movable member is movable in translation relative to the body along the longitudinal direction.

[0010] Furthermore, the displacement of the first arm relative to the body can be a rotational movement, a translational movement or a combination of a rotational movement and of a translational movement.

[0011] Traditionally, the buckets are carried by the frame and by the arms, which allow the opening and the closing of the buckets.

[0012] To make the excavation, the buckets are opened and the grab is dropped into the dig. Then, the buckets are closed in order to collect the cuttings and the grab is pulled up.

[0013] A difficulty arises when the grab encounters hard ground, for example a layer of rock, that it cannot excavate.

[0014] To overcome this difficulty, it is known to use a drill bit in order to break the hard area. A disadvantage of the drill bit is that its effectiveness decreases with each release due to the gradual accumulation of cuttings on the impact area, which has the effect of absorbing the impact shock of the drill bit. Also, the drill bit can break the hard ground only a few centimeters. Furthermore, this tooling is very slow because the method is to hit the hard area using the same material handler that allows the excavation, and this without any visibility of what is done, then pick up what has been

broken using the grab. The use of a drill bit has other disadvantages, in particular noise pollution and the generation of vibrations.

[0015] Another technique consists in using a hydromill. The hydromill is equipped with rotatable cutting drums capable of excavating rock. However, this technique is long to implement and particularly expensive. Furthermore, this technique is sometimes difficult to implement on small-surface construction sites because the installation of the hydromill requires the presence of a grit trap which is particularly bulky.

DISCLOSURE OF THE INVENTION

[0016] One aim of the invention is to propose a drilling machine having a grab frame making it possible to facilitate the excavation of hard areas during the implementation of a clamshell grab drilling method.

[0017] To do so, the drilling machine according to the invention further includes:

[0018] a removable milling device including:

[0019] at least a first mill drum,

[0020] at least a first motor for driving in rotation the first mill drum about a first rotation axis,

[0021] a support carrying the first mill drum and the first motor;

[0022] the drilling machine further including:

[0023] a first dismountable securing device for removably fixing the support to the lower end part of the body,

[0024] a second dismountable securing device for removably fixing the support to the lower end part of the first arm,

[0025] whereby the milling device can be easily dismounted from the frame.

[0026] Thanks to the invention, and more particularly to the first and second dismountable securing devices, the removable milling device can be easily mounted and dismounted, for example to replace the buckets, in particular when it is necessary to excavate a hard area of the ground. Once the hard area has been excavated, the operator dismounts the milling device to replace it with the buckets.

[0027] It is therefore understood that the invention makes it possible to dispense with the use of a drill bit or a hydromill to excavate a localized hard area. As explained above, the operator only needs to dismount the buckets and replace them with the removable milling device.

[0028] Preferably, the first motor is hydraulic. The support includes at least a first hydraulic junction box connected to the first motor.

[0029] Still preferably, the drilling machine includes at least one hydraulic line passing longitudinally through the grab frame in order to supply the first motor with hydraulic energy.

[0030] Advantageously, the first dismountable securing device includes a first part belonging to the body and a second part located on the removable milling device. Preferably, the first part of the first dismountable securing device is also configured to be connected to a first bucket, and more specifically to a first connection part of the first bucket.

[0031] Also, preferably, the first part of the first dismountable securing device can be used to be fixed at the first bucket to the body or to be fixed at the removable milling device to the body.

[0032] It is understood that the drilling machine according to the invention is modular since it can be used as a clamshell grab or milling machine depending on the tooling fixed to the frame.

[0033] Advantageously, the support includes:

[0034] a first support portion;

[0035] a second support portion which is movable relative to the first support portion, the first mill drum and the first motor being mounted on the second support portion,

[0036] wherein the first dismantlable securing device is configured to removably fix the first support portion to the body, and the second dismantlable securing device is configured to removably fix the second support portion to the lower end part of the first arm, whereby the actuation of the actuator device has the effect of moving the first mill drum relative to the frame.

[0037] It is understood that the actuation of the actuator device has the effect of moving the first arm relative to the body. This displacement is directed along a direction perpendicular to the first rotation axis of the first mill drum. The actuation of the actuator device makes it possible to deploy the first mill drum laterally relative to the frame.

[0038] As the second support portion is mounted on the first arm, while being movable relative to the first support portion, the latter being secured to the body, it is understood that the actuation of the actuator device has the effect of moving the second support portion with the first mill drum relative to the body of the frame.

[0039] One advantage is to be able to locally increase the length of the trench, considered in a horizontal plane. This also makes it possible to locally and transversely dig in the ground adjacent to the trench being drilled.

[0040] Another advantage is to be able to bite into the vertical end edge of one or two panels previously existing in the ground.

[0041] Yet another advantage is to be able to easily make a notched joint in the vertical edge.

[0042] Preferably, considered along the longitudinal direction, the movable member is disposed above the first support portion.

[0043] Preferably, the first hydraulic junction box is fixed to the second support portion.

[0044] According to one preferred embodiment:

[0045] the second support portion is pivotally fixed to the first support portion about a first pivoting axis,

[0046] whereby the actuation of the actuator device has the effect of pivoting the first mill drum relative to the frame about the first pivoting axis.

[0047] It is understood that the first pivoting axis is separate and distant from the first rotation axis. Preferably, the first pivoting axis is parallel to the first rotation axis.

[0048] Preferably, considered along the longitudinal direction, the movable member is disposed above the first pivoting axis.

[0049] Preferably, the retraction of the actuator device has the effect of pivoting the second support portion relative to the first support portion in a direction in which the first mill drum deploys transversely away from the body of the frame. Conversely, the deployment of the actuator device has the effect of bringing the first mill drum closer to the body of the frame.

[0050] Again preferably, at least in the deployed position, the second dismantlable securing device is located above the first pivoting axis.

[0051] Advantageously, the first dismantlable securing device includes:

[0052] a mounting element located in the lower part of the body,

[0053] at least a first opening formed in the mounting element,

[0054] a first mounting member comprising:

[0055] a first fixing stud secured to the first support portion and shaped to engage in said first opening, and

[0056] a first locking device cooperating with the first fixing stud to hold the first support portion relative to the mounting element.

[0057] After engagement of the first fixing stud in the first opening, the first fixing stud passes through the mounting element. The first locking device is for example a key which is introduced into an orifice of the first fixing stud, above the plate, to hold the first support portion against the mounting element

[0058] The mounting element preferably includes a plate in which at least the first opening is formed.

[0059] Preferably, the first dismantlable securing device further includes:

[0060] a second opening formed in the mounting element,

[0061] the first mounting member further comprising a second fixing stud secured to the first support portion and shaped to engage in said second opening, and

[0062] a second locking device cooperating with the second fixing stud to block the first support portion relative to the mounting element.

[0063] The second locking device is for example a key which is introduced into an orifice of the second fixing stud, above the mounting element. The first and second fixing studs preferably make it possible to block the first support portion relative to the mounting element.

[0064] Advantageously, the second dismantlable securing device includes a first pivot element connected to the second support portion, and a first orifice formed at the lower end part of the first arm, the first pivot element being shaped to be engaged in the first orifice.

[0065] It is understood that the cooperation of the first pivot element and of the first orifice makes it possible to create a pivot-type hinge between the first arm and the second support portion. This pivot link is preferably oriented along a first pivot axis parallel to the first pivoting axis.

[0066] When the drilling machine operates in grab mode, the first orifice cooperates with the first bucket.

[0067] The first orifice of the first arm corresponds to the first part of the second dismantlable securing device mentioned above.

[0068] During the actuation of the actuator device, the first arm moves relative to the body, which causes the pivoting of the second support portion relative to the body about the first pivoting axis. The second support portion also pivots relative to the first arm about the first pivot axis.

[0069] Advantageously, the milling device further includes:

[0070] a second mill drum,

- [0071] a second motor for driving in rotation the second mill drum about a second rotation axis, the second mill drum and the second motor being carried by the support.
- [0072] It is understood that the milling device can include one or two mill drums, depending on the nature of the work to be performed.
- [0073] Advantageously, the drilling machine according to the invention further includes a third dismountable securing device for removably fixing the support to the lower end portion of the second arm. Preferably, the third dismountable securing device is similar to the second dismountable securing device.
- [0074] Advantageously, the support further includes:
- [0075] a third support portion pivotally fixed to the first support portion about a second pivoting axis, the second mill drum and the second motor being mounted on the third support portion,
- [0076] and in which the third dismountable securing device is configured to removably fix the third support portion to the lower end part of the second arm.
- [0077] In this variant, the distance between the first and second rotation axes of the first and second mill drums can be modified by actuating the actuator device. The two mill drums can be spaced away from each other. Preferably, each of the mill drums can be deployed transversely relative to the frame, independently of each other.
- [0078] Preferably, the second motor is hydraulic and the third support portion further includes a second hydraulic junction box connected to the second motor.
- [0079] Preferably, the second pivoting axis is parallel to the second rotation axis of the second mill drum.
- [0080] More preferably, the first and second pivoting axes are parallel. Without departing from the scope of the present invention, the first and second pivoting axes can be coincident.
- [0081] Advantageously, the third dismountable securing device includes a second pivot element connected to the third support portion, and a second orifice formed at the lower end part of the second arm, the second pivot element being shaped to be engaged in the second orifice.
- [0082] It is understood that the cooperation of the second pivot element and of the second orifice makes it possible to create a pivot-type hinge between the second arm and the third support portion. This pivot link is preferably oriented along a second pivot axis parallel to the second pivoting axis.
- [0083] According to one exemplary embodiment, the actuator device includes a first actuator which is connected to the body and to the first arm.
- [0084] Also, the first actuator acts directly on the first arm.
- [0085] Preferably, in this first exemplary embodiment, the actuator device further includes a second actuator connected to the body and to the second arm to move the second arm relative to the body.
- [0086] In this first exemplary embodiment, the first and second arms are pivotally mounted on each other about a connecting axis of the movable member. The movable member forms a roller that can be moved in translation relative to the body along the longitudinal direction while being guided in translation by the oblong guide device in which it is housed.
- [0087] It is understood that the mobile member is preferably located in the body of the frame.
- [0088] Without departing from the scope of the present invention, the actuator device may include a main actuator which is connected to the body and to the movable member to move the movable member relative to the body. In this embodiment, the first actuator acts directly on the movable member, which then acts on the first and second arms.
- [0089] The invention also relates to a variable-geometry removable milling device for a grab frame, including:
- [0090] first and second mill drums;
- [0091] first and second motors for driving in rotation the first and second mill drums about first and second rotation axes;
- [0092] a support comprising:
- [0093] a first support portion equipped with a first member for mounting on the frame,
- [0094] a second support portion which is movable relative to the first support portion, the first mill drum and the first motor being mounted on the second support portion, the second support portion being equipped with a second member for mounting on the frame,
- [0095] a third support portion which is movable relative to the first support portion, the second mill drum and the second motor being mounted on the third support portion, the third support portion being equipped with a third member for mounting on the frame.
- [0096] It is understood that the first mounting member is intended to be fixed to a mounting element disposed at the lower end of the frame. The second mounting member is configured to be fixed to a first arm of the grab frame, while the third mounting member is configured to be mounted on a second arm of the grab frame.
- [0097] The milling device has a retracted position in which the distance between the first and second mill drums is minimal. In this retracted position, the second and third supports preferably bear against each other, which makes it possible to maintain a minimum spacing between the mill drums, in order to prevent them from coming into contact against each other, which could damage them.
- [0098] Advantageously, the second support portion is pivotally fixed to the first support portion about a first pivoting axis, and the third support portion is pivotally fixed to the first support portion about a second pivoting axis.
- [0099] The pivoting amplitude of the second support portion is preferably comprised between 0 and 60°.
- [0100] Preferably, the first and second pivoting axes are parallel to the rotation axis of the first mill drum.
- [0101] According to one variant of embodiment, the first and second pivoting axes are coincident.
- [0102] Advantageously, the second and third members for mounting on the frame are located above the first and second pivoting axes.
- [0103] Advantageously, the second mounting member includes a first pivot element, which extends parallel to the first pivoting axis. This first pivot element is configured to cooperate with a first orifice of the first arm of the grab frame.
- [0104] Advantageously, the third mounting member includes a second pivot element, which extends parallel to the second pivoting axis. This second pivot element is configured to cooperate with a second orifice of the second arm of the grab frame.

[0105] Advantageously, the first mounting member includes at least one fixing stud protruding from a board of the first support portion. This fixing stud is configured to be engaged in a first opening of a mounting element of the body of the frame. Preferably, the first mounting member includes two fixing studs.

[0106] Preferably, considered along a transverse direction, perpendicular to the longitudinal direction, and perpendicular to the first pivoting axis, the first and second pivoting axes are located between the first and second pivot axes.

[0107] Again preferably, considered in projection in a plane perpendicular to the first pivoting axis, the first and second pivot axes are located above the first and second pivoting axes; the first and second rotation axes are located below the first and second pivoting axes.

[0108] Preferably, the milling device further includes a first locking device intended to cooperate with the first fixing stud.

[0109] According to one preferred embodiment, the first motor is a hydraulic motor, and at least the second support portion further includes a first hydraulic junction box connected to the first motor.

[0110] Preferably, the second motor is also a hydraulic motor, and the third support portion includes a second hydraulic junction box connected to the second motor.

[0111] The first and second hydraulic junction boxes are adapted to be connected to hydraulic hoses disposed in the grab frame.

[0112] Advantageously, the milling device has a deployed position and a retracted position in which a gap between the first and second mill drums is minimal, the milling device further including an abutment device in order to maintain a minimum gap between the first and second mill drums when the milling device is in the retracted position.

[0113] One advantage is to prevent the mill drums from coming into contact with each other when the milling device is in the retracted position, which would be likely to damage them.

[0114] Preferably, but not exclusively, the second and third support portions are shaped to come into contact with each other when the milling device is in the retracted position, the abutment device being constituted by abutment faces disposed oppositely on each of the second and third support portions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0115] The invention will be better understood upon reading the following description of embodiments of the invention given by way of non-limiting examples, with reference to the appended drawings, in which:

[0116] FIG. 1 is a front view of one embodiment of the drilling machine according to the invention;

[0117] FIG. 2 illustrates the machine of FIG. 1, the milling device being dismounted from the frame;

[0118] FIG. 3 is a front view of a first exemplary embodiment of the removable milling device according to the invention;

[0119] FIG. 4 is a detail view of the second mounting member according to section IV-IV;

[0120] FIG. 5 is a bottom view of the frame of the drilling machine of FIG. 1;

[0121] FIG. 6 is a perspective view of a second exemplary embodiment of the removable milling device, in the retracted position;

[0122] FIG. 7 illustrates the milling device of FIG. 6 in the deployed position;

[0123] FIG. 8 shows the drilling machine of FIG. 1, in the trench bottom, with the milling device in the retracted position to drill a hard area;

[0124] FIG. 9 illustrates an example of use of the drilling machine of FIG. 1 to make local excavations in bars at different depths, the milling device being in the deployed position;

[0125] FIG. 10 shows an example of use of the drilling machine of FIG. 1 illustrating a step during which the milling device bites into the vertical edges of two adjacent panels;

[0126] FIG. 11 is a view taken in a horizontal plane, illustrating the bitten area during the step of FIG. 10; and

[0127] FIG. 12 illustrates one variant of FIG. 11, in which the panels are bitten over a fraction of their thickness so as to create a notched joint.

DETAILED DESCRIPTION

[0128] FIG. 1 illustrates a first embodiment of a drilling device 10 for making a trench in the ground.

[0129] In known manner, the drilling machine 10 is suspended from the end of a mast of a carrier (not illustrated here).

[0130] The drilling machine 10 in this example includes a grab frame 12 which is suspended from the mast of the carrier by means of a suspension element 14. In this non-limiting example, this suspension element is connected to a block 15, which is itself fixed to a rotary joint 17.

[0131] The grab frame 12 further includes a body 16 which extends along a longitudinal direction L between an upper end part 16a and a lower end part 16b.

[0132] The frame 12 moreover includes two guide modules 20, 22 disposed on either side of the body 16. These guide modules are intended to bear against the side walls of the trench in order to guide the vertical displacement of the drilling machine 10. In this non-limiting example, the height of the guide modules is greater than that of the body.

[0133] The body 16 moreover includes a translational guide device 24 which is located substantially in the central part of the body. In this example, the guide device 24 is in the form of a plate 26 in which an oblong opening 28 which extends along the longitudinal direction is formed. This translational guide device will be described in more detail below.

[0134] The grab frame 12 furthermore includes a movable member 32 which cooperates with the translational guide device 24 so that the movable member 32 can be moved relative to the body 16 along the longitudinal direction L. The movable member 32 is disposed inside the body 16. In this example, the movable member 32 is in the form of a roller 33 which is slidably mounted, relative to the body, inside the oblong opening 28 along the longitudinal direction L.

[0135] The grab frame 12 furthermore includes a first arm 34 which has an upper end part 34a connected to the movable member 32 so that the first arm 34 is pivotable relative to the movable member 32 about an axis X which is orthogonal to the longitudinal direction L. The first arm moreover includes a lower end part 34b, opposite to the upper end part 34a.

[0136] The grab frame 12 moreover includes a second arm 36 which has an upper end part 36a connected to the

movable member **32** so that the second arm **36** is pivotable relative to the movable member **32** about an axis **X** which is orthogonal to the longitudinal direction **L**. The second arm moreover includes a lower end part **36b**, opposite to the upper end part **36a**. It is therefore understood that the first and second arms **34**, **36** are also pivotable relative to each other about the axis **X**.

[0137] The grab frame **12** moreover includes an actuator device **37** comprising a first actuator **38** which, in this example, is pivotally connected to the body **16** by its first end **38a**, and is pivotally connected to the lower end part **34b** of the first arm **34** by its second end **38b**. The first end **38a** is located in this example above the oblong opening.

[0138] It is understood that the first actuator **38** makes it possible to move the first arm **34** relative to the body **16**. In this example, the first actuator is a hydraulic cylinder.

[0139] Still in this example, it is understood that the actuation of the first actuator **38** has the effect of pivoting the first arm relative to the body about the axis **X** while moving the first arm **34** along the longitudinal direction **L**. The relative movement of the first arm **34** relative to the body **16** is the combination of a rotation about the axis **X** and of a translation along the longitudinal direction **L**.

[0140] The actuation device **37** further includes a second actuator **40**, which also constituted by a hydraulic cylinder. The second actuator **40** includes a first end **40a** which is pivotally connected relative to the body **16**, and a second end **40b** which is pivotally connected to the second arm **36** to move the second arm **36** relative to the body **16**. Again, using FIG. 1, it is understood that the actuation of the second actuator **40** has the effect of pivoting the second arm **40** relative to the body about the axis **X**, and also of moving the second arm **40** along the longitudinal direction **L**. The displacement of the second arm **36** relative to the body **16** under the action of the second actuator **40** is a combination of a rotational movement about the connecting axis **X** and of a translational movement along the longitudinal direction **L**.

[0141] In accordance with the invention, as illustrated in FIG. 2, the drilling machine **10** further includes a removable milling device **100** which is mounted in the lower part of the grab frame **12**.

[0142] The removable milling device **100** can be easily and quickly dismantled from and mounted on the grab frame **12**. As explained above, the operator can easily and quickly mount the removable milling device **100** on the frame **12** after having dismantled the buckets of the grab which are traditionally fixed to the first and second arms **34**, **36**, as well as to the body **16** of the frame **12**.

[0143] The removable milling device **100** includes a first mill drum **102** which is rotatable about a first rotation axis **A1**. The first mill drum **102** is driven in rotation about the first rotation axis **A1** by a first motor, not illustrated here, which is located inside the first mill drum **102**. Such a mounting, called "floating" mounting is known otherwise, and will not be described in more detail here.

[0144] The removable milling device **100** further includes a second mill drum **104** rotatable about a second rotation axis **A2**, parallel in this example to the first rotation axis **A1**. The second mill drum **104** is driven in rotation by a second motor (not illustrated here), which is also disposed inside the second mill drum.

[0145] Without departing from the scope of the present invention, the first and second motors could be disposed outside the first and second mill drums, above the first and second drums.

[0146] In this example, the first and second motors are hydraulic motors.

[0147] As illustrated in FIGS. 3 and 5, which show the removable milling device **100** in greater detail, it can be seen that each of the first and second mill drums **102**, **104** consists of two half-drums carrying cutting tools **103**, which are fixed to holding plates **105**, **107**. These plates are crossed by hydraulic lines (not illustrated here) which are respectively connected to a first hydraulic junction box **106** and a second hydraulic junction box **108**, these hydraulic junction boxes being for their part connected to hydraulic hoses (not illustrated here) which extend into the frame which have the function of supplying the first and second motors with hydraulic energy.

[0148] The removable milling device **100** further includes a support **110** which carries the first mill drum **102**, the first motor, the second mill drum **104** and the second motor.

[0149] It is understood that the support also carries the first and second hydraulic junction boxes **106**, **108**.

[0150] Referring to FIGS. 1 and 2, it is noted that the drilling machine **10** further includes a first dismantlable securing device **120** for removably fixing the support **110** to the lower end part **16b** of the body **16**.

[0151] In this example, the first dismantlable securing device **120** includes a mounting element **122** belonging to the body of the frame **12**, and a first mounting member **124** belonging to the removable milling device **100**.

[0152] In this example, the mounting element **122** is disposed at the lower end of the body. The mounting element is equipped with a first opening **126** and a second opening **128** which are formed in a plate **125** of the mounting element **123**.

[0153] Referring to FIG. 3, it can be seen that the first dismantlable securing device **120** further includes a first fixing stud **140** secured to the support **110** and shaped to engage in the first opening **126**, as well as a first locking device **142**, cooperating with the first fixing stud **140** to hold the support relative to the plate of the mounting element. In this example, the first locking device **142** includes a first removable key which is shaped to pass transversely through the first fixing stud **140**, the key protruding on either side of the first fixing stud **140**. When the milling device is fixed to the body of the grab frame, it is understood that the plate **125** of the mounting element **123** is held between the support and the key of the first locking device **142**.

[0154] In this example, the first dismantlable securing device further includes a second fixing stud **144**, identical to the first fixing stud **140**, this second fixing stud **144** being secured to the support **110** and shaped to engage in the second opening **128**. There is also provided a second locking device **146** also in the form of a removable key cooperating with the second fixing stud to block the support relative to the plate of the mounting element.

[0155] In accordance with the invention, the drilling machine further includes a second dismantlable securing device **150** for removably fixing the support **110** to the lower end part **34b** of the first arm **34**.

[0156] The second dismantlable securing device **150** includes a second member for mounting **152** on the frame which is disposed on the support **110**.

[0157] In this example, as illustrated in FIG. 4, the second mounting member 152 includes a first pivot element 154 constituted by a bracket 154a secured to the support and equipped with two orifices 154b disposed oppositely and shaped to receive a removable fixing bolt 154c.

[0158] The second dismountable securing device 150 further includes a first orifice 160 formed at the lower end part 34b of the first arm 34. When the milling device is mounted on the frame, the lower end of the second arm is engaged in the bracket 154a and the fixing bolt 154c is engaged in the first orifice 160.

[0159] The drilling machine further includes a third dismountable securing device 151 for removably fixing the support 110 to the lower end part 36b of the second arm 36. The third dismountable securing device 151 includes a third member for mounting 156 on the frame which is disposed on the support.

[0160] The third mounting member 156 includes a second pivot element 162, similar to first pivot element 154. The second pivot element 162 is constituted by a bracket 162a secured to the support. The bracket 162a is equipped with two orifices disposed oppositely and shaped to receive a fixing bolt 162b. The second dismountable securing device further includes a second orifice 164 formed at the lower end part 36b of the second arm 36. When the milling device is mounted on the frame, the lower end of the second arm is engaged in the bracket 162a and the fixing bolt 162b of the second pivot element 162 is engaged in the second orifice 164.

[0161] Here again, the second pivot element 162 can be easily removed from the third mounting member 156 in order to quickly dismount the support 110 from the second arm 36.

[0162] Also, thanks to the invention, the milling device can be easily and quickly mounted on and dismantled from the frame.

[0163] According to a second advantageous embodiment, illustrated in particular in FIGS. 6 and 7, the removable milling device 100 is of variable geometry. The milling device of FIGS. 6 and 7 differs from the first exemplary embodiment of FIG. 3 in that the first and second mill drums 102, 104 can be spaced apart from each other.

[0164] To do so, in this example, the support 110 includes a first support portion 200 and a second support portion 202 which is movable relative to the first support portion 200, so that the first mill drum 102 can be moved transversely relative to the body of the frame.

[0165] As understood with FIGS. 6 and 7, the first mill drum 102 and the first motor are carried by the second support portion 202. The first hydraulic junction box 106 is fixed to the second support portion 202. In this example, the second support portion 202 is pivotally fixed to the first support portion 200 about a first pivoting axis B1. It can be seen that this first pivoting axis B1 is parallel to the first rotation axis A1 of the first mill drum 102.

[0166] Moreover, in this example, considered in projection along a transverse direction T which is perpendicular to the longitudinal direction L and perpendicular to the first rotation axis A1, the first pivoting axis B1 is disposed between the first and second rotation axes A1, A2 of the first and second mill drums 102, 104.

[0167] Like the first embodiment, the first dismountable securing device 120 is configured to removably fix the first support portion 200 to the body 16. Here again, the first

dismountable securing device 120 includes the first mounting member aforementioned which is equipped with the first and second fixing studs 140, 144 and with the first and second locking devices 142, 146 previously described. The second dismountable securing device 150 is configured to removably fix the second support portion 202 to the lower end part 34b of the first arm 34, whereby the actuation of the actuator device has the effect of moving the first mill drum 102 relative to the frame.

[0168] More specifically, in this example, the actuation of the first actuator of the actuator device has the effect of pivoting the first mill drum 102 relative to the frame about the first pivoting axis B1. Like the first embodiment, the second dismountable securing device 150 includes a second mounting member 152 comprising a first pivot element 154 belonging to the second support portion. The second dismountable securing device further comprises a first orifice 160 formed in the lower end part 34b of the first arm 34. As in the embodiment of FIG. 3, the first pivot element 154 is shaped to be engaged in the first orifice 160. Also, the second support portion 202 is pivotally fixed to the first arm 34 about a pivot axis C1 which is parallel to the first pivoting axis B1.

[0169] In the deployed position, the second dismountable securing device 150 is located above the first pivoting axis B1.

[0170] The drilling machine further includes a third support portion 204 which is pivotally fixed to the first support portion 200 about a second pivoting axis C2. The second mill drum 104 and the second motor are carried by the third support portion 204. The same applies to the second hydraulic junction box 108.

[0171] Moreover, the third dismountable securing device 151 is configured to removably fix the third support portion 204 to the lower end part 36b of the second arm 36.

[0172] Also, in this example, the third support portion 204 is pivotally mounted on the second arm 36 about a second pivot axis C2 which is parallel to the first pivot axis C1, and to the second pivoting axis B2.

[0173] FIG. 6 illustrates the variable-geometry milling device in the retracted position, while FIG. 7 shows it in the deployed position. In the retracted position, the distance between the first and second rotation axes A1, A2 is minimal. In other words, the gap between the first and second mill drums is minimal, on the order of a few centimeters. The passage between the retracted position and the deployed position is made by rotation of the second and third support portions about the first and second pivoting axes B1, B2. The deployment is obtained by retraction of the first and second actuators 38, 40.

[0174] As can be seen in FIG. 6, the milling device includes an abutment device 230 for maintaining a minimum gap between the first and second mill drums 102, 104.

[0175] This abutment device 230 makes it possible to ensure a minimum distance between the rotation axes A1 and A2 of the first and second mill drums 102, 104 when the milling device is in the retracted position. In this example, the abutment device 230 includes a first abutment face 232 on the second support portion 202 and a second abutment face 234 on the third support portion 204.

[0176] As understood with FIG. 6, in the retracted position, the abutment faces 232 and 234 come into contact with each other in order to maintain a minimum spacing between

the first and second rotation axes of the first and second mill drums **102**, **104** so that these do not touch each other.

[0177] It is also notable that, considered in projection in the aforementioned transverse direction T, the first and second pivoting axes B1, B2 are located between the first and second pivot axes C1, C2.

[0178] Still in this same reference frame, the first rotation axis A1 is located between the first pivot axis C1 and the first pivoting axis B1, while the second rotation axis A2 is located between the second pivoting axis B2 and the second pivot axis C2.

[0179] Moreover, considered in a plane P perpendicular to the first pivoting axis, the first and second pivot axes C1, C2 are located above the first and second pivoting axes B1, B2, while the first and second rotation axes A1, A2 are located below the first and second pivoting axes B1, B2.

[0180] FIG. 8 illustrates the drilling machine according to the second embodiment during the excavation of a hard area K of the ground, the drums being in the retracted position.

[0181] FIG. 9 illustrates the drilling machine **10** according to the invention in which the variable geometry drilling device is in the deployed position, which makes it possible to excavate cavities E in the ground on either side of the trench being excavated.

[0182] In FIG. 10, the drilling machine **10** is used to bite into the vertical edges **300a**, **302a** of two primary panels **300**, **302** disposed on either side of the machine. After having excavated a trench between the two primary panels using the drilling machine **10**, the milling device then being in the retracted position, the milling device is brought into the deployed position and the drilling machine **10** is pulled up so as to bite into the primary panels over a depth p, this depth being considered along a horizontal direction.

[0183] FIG. 11 illustrates a horizontal section of the drilling, the vertical edges **300a**, **300b** of the panels are bitten over the entire thickness e of the panels. The bitten areas are referenced **304**, **306**.

[0184] In FIG. 12, which illustrates a variant of the drilling illustrated in FIG. 11, the vertical edges **300a**, **300b** of the panels are bitten over a fraction of the thickness e of the panels. The bitten areas are referenced **306**, **308**, and form a notched joint. To do so, the width of the mill drums will be adapted to the desired width of the notched joints.

1-22. (canceled)

23. A drilling machine including:

a grab frame which comprises:

a body extending along a longitudinal direction between an upper end part and a lower end part, the body having a guide device extending along the longitudinal direction,

a movable member cooperating with the guide device so that the movable member is movable relative to the body along the longitudinal direction;

a first arm pivotable relative to the movable member, the first arm having a lower end part;

a second arm pivotable relative to the movable member, the second arm having a lower end part, the first and second arms being pivotable relative to each other,

at least one actuator device connected to the body to move at least the first arm relative to the body;

said drilling machine being characterized in that it further includes:

a removable milling device including:

at least a first mill drum,

at least a first motor for driving in rotation the first mill drum about a first rotation axis,

a support carrying the first mill drum and the first motor;

the drilling machine further including:

a first dismountable securing device for removably fixing the support to the lower end part of the body,

a second dismountable securing device for removably fixing the support to the lower end part of the first arm,

whereby the milling device can be easily dismounted from the frame.

24. The drilling machine according to claim 23, wherein the support includes:

a first support portion;

a second support portion which is movable relative to the first support portion, the first mill drum and the first motor being mounted on the second support portion,

wherein the first dismountable securing device is configured to removably fix the first support portion to the body, and wherein the second dismountable securing device is configured to removably fix the second support portion to the lower end part of the first arm, whereby the actuation of the actuator device has the effect of moving the first mill drum relative to the frame.

25. The drilling machine according to claim 24, wherein: the second support portion is pivotally fixed to the first support portion about a first pivoting axis,

whereby the actuation of the actuator device has the effect of pivoting the first mill drum relative to the frame about the first pivoting axis.

26. The drilling machine according to claim 24, the first dismountable securing device includes:

a mounting element located in the lower end part of the body,

at least a first opening formed in the mounting element,

a first mounting member including:

a first fixing stud secured to the first support portion and shaped to engage in said first opening; and

a first locking device cooperating with the first fixing stud to hold the first support portion relative to the mounting element.

27. The drilling machine according to claim 26, wherein the first dismountable securing device further includes:

a second opening formed in the mounting element,

the first mounting member further comprising:

a second fixing stud secured to the first support portion and shaped to engage in said second opening, and

a second locking device cooperating with the second fixing stud to block the first support portion relative to the mounting element.

28. The drilling machine according to claim 24, wherein the second dismountable securing device includes a first pivot element connected to the second support portion, and a first orifice formed at the lower end part of the first arm, the first pivot element being shaped to be engaged in the first orifice.

29. The drilling machine according to claim 23, wherein the milling device further includes:

a second mill drum,

a second motor for driving in rotation the second mill drum, the second mill drum and the second motor being carried by the support.

30. The drilling machine according to claim **23**, further including a third dismountable securing device for removably fixing the support to the lower end portion of the second arm.

31. The drilling machine according to claim **24**, wherein the milling device further includes:

a second mill drum,

a second motor for driving in rotation the second mill drum, the second mill drum and the second motor being carried by the support, wherein the support further includes:

a third support portion pivotally fixed to the first support portion about a second pivoting axis, the second mill drum and the second motor being mounted on the third support portion,

and wherein the third dismountable securing device is configured to removably fix the third support portion to the lower end part of the second arm.

32. The drilling machine according to claim **25**, wherein the support further includes:

a third support portion pivotally fixed to the first support portion about a second pivoting axis, the second mill drum and the second motor being mounted on the third support portion,

and wherein the third dismountable securing device is configured to removably fix the third support portion to the lower end part of the second arm,

and wherein the first and second pivoting axes are parallel.

33. The drilling machine according to claim **31**, wherein the third dismountable securing device includes a second pivot element connected to the third support portion, and a second orifice formed at the lower end part of the second arm, the second pivot element being shaped to be engaged in the second orifice.

34. The drilling machine according to claim **23**, wherein the actuator device includes a first actuator which is connected to the body and to the first arm.

35. The drilling machine according to claim **34**, wherein the grab frame further includes a second actuator connected to the body and to the second arm for moving the second arm relative to the body.

36. A variable-geometry milling device for a grab frame, including:

first and second mill drums;

first and second motors for driving in rotation the first and second mill drums about first and second rotation axes;

a support comprising:

a first support portion equipped with a first member for mounting on the frame,

a second support portion which is movable relative to the first support portion, the first mill drum and the first motor being mounted on the second support portion, the second support portion being equipped with a second member for mounting on the frame,

a third support portion which is movable relative to the first support portion, the second mill drum and the second motor being mounted on the third support portion, the third support portion being equipped with a third member for mounting on frame.

37. A milling device according to claim **36**, wherein the second support portion is pivotally fixed to the first support portion about a first pivoting axis, and the third support portion is pivotally fixed to the first support portion about a second pivoting axis.

38. The milling device according to claim **37**, wherein the first and second pivoting axes are parallel to the rotation axis of the first mill drum.

39. The milling device according to claim **37**, wherein the second and third members for mounting on the frame are located above the first and second pivoting axes.

40. The milling device according to claim **36**, wherein the second mounting member includes a first pivot element, which extends parallel to the first pivoting axis.

41. The milling device according to claim **36**, wherein the first mounting member includes at least one fixing stud protruding from a board of the first support portion.

42. The milling device according to claim **36**, wherein the first motor is a hydraulic motor, and wherein at least the second support portion further includes a hydraulic junction box connected to the first motor.

43. The milling device according to claim **36**, wherein the milling device has a deployed position and a retracted position in which a gap between the first and second mill drums is minimal, the milling device further including an abutment device in order to maintain a minimum gap between the first and second mill drums when the milling device is in the retracted position.

44. The milling device according to claim **43**, wherein the second and third support portions are shaped to come into contact against each other when the milling device is in the retracted position, the abutment device being constituted by abutment faces disposed oppositely on each of the second and third support portions.

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