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(54) **METHOD FOR ARRANGING A PILE, SUCH AS A CONCRETE PILE, IN THE GROUND**

VERFAHREN ZUM ANORDNEN EINES PFAHLS WIE Z. B. EINES BETONPFAHLS IM BODEN

PROCÉDÉ D'AGENCEMENT D'UN PIEU, TEL QU'UN PIEU EN BÉTON, DANS LE SOL

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**Description**

**[0001]** The invention relates to a method for arranging a pile, such as a concrete pile, in the ground.

**[0002]** Piles, such as concrete piles, are usually arranged in the ground by pile-driving. This causes significant vibration in the ground, which can be detrimental to the surrounding land and/or buildings.

**[0003]** An alternative is to drill a hole and then place reinforcing steel therein, and then pour concrete into the hole so that a concrete pile is formed in situ. After pouring, the concrete must first cure for several weeks before load may be exerted on the formed concrete piles.

**[0004]** A second alternative is to press concrete piles into the ground. The drawback of this technique is that the machine with which the piles are pressed into the ground must have a mass of a magnitude such that the pressing force can be counteracted therewith. This technique can thereby only be applied on a ground surface which is sufficiently stable for the weight of the machine and at locations which are accessible to such a large machine.

**[0005]** It is now an object of the invention to reduce or even obviate the above stated drawbacks.

**[0006]** This object is achieved according to the invention with a method for arranging a pile, such as a concrete pile, in the ground, which method comprises the steps of:

- arranging a number of elongate plates in the ground one by one;
- arranging on the upper sides of the elongate plates pressed into the ground a frame connecting all upper sides to each other;
- providing a pile, such as a concrete pile;
- pressing the pile into the ground, wherein the pressing force is generated between the pile and the frame.

**[0007]** Pressing elongate plates into the ground one by one can be done with a relatively small pressing force and thereby with a relatively light machine. Use can be made here of a sheet pile press as described in the as yet unpublished Netherlands patent application no. 2026987 of applicant. Also prior art documents EP 1 806 455 A and US 4 709 764 A describe a machine of that kind.

**[0008]** Depending on the number of elongate plates arranged in the ground, a determined tractive force can be withstood by the joint friction of the plates in the ground. This joint friction can be used as opposing force when pressing piles, such as concrete piles, into the ground.

**[0009]** With the method it is thus possible to still press concrete piles into the ground without vibration and without heavy machinery in that use is made of the joint "sticking force" of the elongate plates arranged individually in the ground.

**[0010]** In a preferred embodiment of the method according to the invention pressing the pile into the ground takes place in steps with press strokes, wherein each

press stroke comprises of:

- clamping the pile relative to the frame at a starting position;
- pressing the pile into the ground over a determined stroke; and
- releasing the pile at the end of the stroke.

**[0011]** Pressing the pile into the ground in steps with press strokes makes it possible to use small actuators, such as hydraulic cylinders. When the pile must be pressed into the ground in one single stroke, actuators with a stroke equal to the length of the pile are necessary. By pressing in steps as according to the invention an almost unlimited length can be pressed into the ground with a small stroke. Actuators with a short stroke can furthermore generate a great force more easily than actuators with a long stroke.

**[0012]** A preferred embodiment of the method further comprises the step of removing the elongate plates from the ground one by one after the pile has been pressed into the ground.

**[0013]** Because the friction of a single elongate plate is limited, the elongate plates can be removed one by one after the pile has been arranged. The pile can here optionally be used as support.

**[0014]** The elongate plates are preferably sheet pile profile plates. Sheet pile profile plates are highly suitable for being arranged in the ground and being removed therefrom again.

**[0015]** The invention further comprises a device for a method according to the invention, which device comprises:

- a frame with mounting means for mounting the frame on the upper sides of elongate plates pressed into the ground;
- at least one press cylinder which is arranged with one end on the frame;
- a clamping device for clamping a pile, such as a concrete pile, which clamping device is arranged on the other end of the at least one press cylinder.

**[0016]** The mounting means for mounting the frame preferably comprise hydraulic grippers on the upper sides of elongate plates pressed into the ground for the purpose of clamping the frame on the upper edge of an elongate plate.

**[0017]** With hydraulic grippers a coupling to the elongate plates can be formed rapidly and a great clamping force can be brought about.

**[0018]** In a further embodiment of the device according to the invention the clamping device comprises at least one hydraulic gripper for clamping round a pile.

**[0019]** Because it is preferred according to the method according to the invention to arrange the pile into the ground in steps with press strokes, it is advantageous if the hydraulic gripper can be controlled easily and at the

same time can generate a good clamping force.

**[0020]** In another embodiment of the device according to the invention the frame comprises at least one transverse beam, wherein the mounting means are arranged on either end of the transverse beam, wherein the press cylinder is slidable along the transverse beam and is arranged slidably thereon.

**[0021]** Arranging a transverse beam with both ends on plates pressed into the ground makes it possible to displace the press cylinder between these two ends and so press a row of concrete piles into the ground, without new plates having to be arranged in the ground for each concrete pile.

**[0022]** In a further embodiment of the device according to the invention the frame further comprises two parallel longitudinal beams arranged at a mutual distance, wherein the at least one transverse beam is arranged on the longitudinal beams for sliding in longitudinal direction of the longitudinal beams and wherein the mounting means are arranged on the longitudinal beams.

**[0023]** Owing to the longitudinal beams the press cylinder is displaceable in two directions, whereby concrete piles can be pressed into the ground at random positions within an operational area.

**[0024]** These and other features of the invention are further elucidated with reference to the accompanying drawings.

Figures 1A-1D show the different steps of the method according to the invention.

Figure 2 shows a perspective view of an embodiment of the device according to the invention.

Figure 3 shows a side view of a second embodiment of the device according to the invention.

Figure 4 shows a second side view of the device according to figure 3.

Figure 1A shows a bottom 1 in which one elongate plate 2 has already been arranged and wherein three separate plates 3, 4, 5 must still be arranged in bottom 1.

**[0025]** In figure 1B all four elongate plates 2, 3, 4, 5 have been arranged in bottom 1.

**[0026]** As shown in figure 1C, a frame 7 is then arranged on the upper side of the elongate plates 2, 3, 4, 5 via hydraulic grippers 6. Grippers 6 can be displaced in the height relative to frame 7 by hydraulic cylinders 8. A clamping device of plates 9 and cylinders 10 is further provided on frame 7.

**[0027]** In figure 1D a concrete pile 11 is clamped between plates 9 of the clamping device. By moving frame 7 up and downward with cylinders 8 and releasing clamping device 9, 10 in the upward movement and clamping the concrete pile 11 in the downward movement the concrete pile 11 is thus pressed into the ground.

**[0028]** Since the overall area of the elongate plates 2, 3, 4, 5 which is in contact with bottom 1 is considerably larger than the contact surface of concrete pile 11, this

concrete pile 11 can be pressed into the ground in simple manner without plates 2, 3, 4, 5 being pressed out of bottom 1.

**[0029]** After pile 11 has been arranged, each elongate plate 2, 3, 4, 5 can be pulled out of the ground again individually, wherein concrete pile 11 is for instance used as support point.

**[0030]** Figure 2 shows the device according to the invention in perspective view. The grippers 6 are here clamped onto the upper edges of the elongate plates 2, 3, 4, 5. Provided between frame 7 and grippers 6 are hydraulic cylinders 8 so that frame 7 can be moved up and downward relative to grippers 6.

**[0031]** A clamping device of plates 9 and hydraulic cylinders 10, between which a pile 11 is clamped, is further provided on frame 7.

**[0032]** Suitable control of hydraulic cylinders 8 and hydraulic cylinders 10 enables the pile 11 to be pressed into the bottom in steps with press strokes.

**[0033]** Figure 3 shows a second embodiment 20 of a device according to the invention. In bottom 21 elongate plates 22 have been pressed into the bottom 21 at two separate locations. Longitudinal beams 23 have been mounted on these plates. Transverse beams 24 have then been arranged slidably on these longitudinal beams 23 (see also figure 4).

**[0034]** Arranged along the transverse beams 24 is a guide 25, on which is placed a yoke 26 with a press cylinder 27 therebetween. Press cylinder 27 exerts a pressing force on a guide 28, which is provided around the yoke 26. Provided on this guide 28 is a clamp 29, 30, which clamps a concrete pile 31 and so presses it into bottom 21.

## Claims

1. Method for arranging a pile, such as a concrete pile, in the ground, which method comprises the steps of:

- arranging a number of elongate plates (2-5) in the ground one by one;
- arranging on the upper sides of the elongate plates pressed (8) into the ground (1) a frame (7) connecting (6) all upper sides to each other;

## characterized by:

- providing a pile (11), such as a concrete pile;
- pressing the pile into the ground, wherein the pressing force is generated between the pile and the frame.

2. Method according to claim 1, wherein pressing the pile into the ground takes place in steps with press strokes, wherein each press stroke comprises of:

- clamping the pile relative to the frame at a

starting position;

- pressing the pile into the ground over a determined stroke; and
- releasing the pile at the end of the stroke.

3. Method according to claim 1 or 2, further comprising the step of removing the elongate plates from the ground one by one after the pile has been pressed into the ground.

4. Method according to any one of the foregoing claims, wherein the elongate plates are sheet pile profile plates.

5. Device suitable for carrying out a method according to any one of the foregoing claims, which device comprises:

- a frame (7) with mounting means (6) for mounting the frame on the upper sides of elongate plates (2-5) pressed into the ground (1);
- at least one press cylinder (8) which is arranged with one end on the frame;

**characterized by:**

- a clamping device (9, 10) for clamping a pile (11), such as a concrete pile, which clamping device is arranged on the other end of the at least one press cylinder.

6. Device according to claim 5, wherein the mounting means for mounting the frame comprise hydraulic grippers on the upper sides of elongate plates pressed into the ground for the purpose of clamping the frame on the upper edge of an elongate plate.

7. Device according to claim 5 or 6, wherein the clamping device comprises at least one hydraulic gripper for clamping round a pile.

8. Device according to any one of the foregoing claims 5-7, wherein the frame comprises at least one transverse beam, wherein the mounting means are arranged on either end of the transverse beam, wherein the press cylinder is slidable along the transverse beam and is arranged slidably thereon.

9. Device according to claim 8, wherein the frame further comprises two parallel longitudinal beams arranged at a mutual distance, wherein the at least one transverse beam is arranged on the longitudinal beams for sliding in longitudinal direction of the longitudinal beams and wherein the mounting means are arranged on the longitudinal beams.

## Patentansprüche

1. Verfahren zum Anordnen eines Pfahls, beispielsweise eines Betonpfahls, im Boden, wobei das Verfahren die folgenden Schritte umfasst:

- Anordnen einer Reihe von länglichen Platten (2-5) nacheinander auf dem Boden;
- Anordnen eines alle Oberseiten miteinander verbindenden (6) Rahmens (7) auf den Oberseiten der in den Boden (1) eingedrückten länglichen Platten (8);

**gekennzeichnet durch:**

- Bereitstellen eines Pfahls (11), beispielsweise eines Betonpfahls;
- Eindringen des Pfahls in den Boden, wobei die Druckkraft zwischen dem Pfahl und dem Rahmen erzeugt wird.

2. Verfahren nach Anspruch 1, wobei das Eindringen des Pfahls in den Boden in Schritten mit Presshuben erfolgt, wobei jeder Presshub Folgendes umfasst:

- Einspannen des Pfahls gegenüber dem Rahmen in einer Ausgangsposition;
- Eindringen des Pfahls in den Boden über einen bestimmten Hub; und
- Loslassen des Pfahls am Ende des Hubes.

3. Verfahren nach Anspruch 1 oder 2, das weiter den Schritt umfasst, die länglichen Platten nacheinander aus dem Boden zu entfernen, nachdem der Pfahl in den Boden gedrückt worden ist.

4. Verfahren nach einem der vorstehenden Ansprüche, wobei die länglichen Platten Spundwandprofilplatten sind.

5. Vorrichtung zur Ausführung eines Verfahrens nach einem der vorstehenden Ansprüche, wobei die Vorrichtung Folgendes umfasst:

- einen Rahmen (7) mit Befestigungsmitteln (6) zur Befestigung des Rahmens an den Oberseiten von länglichen Platten (2-5), die in den Boden (1) gedrückt werden;
- mindestens einen Presszylinder (8), der mit einem Ende am Rahmen angeordnet ist;

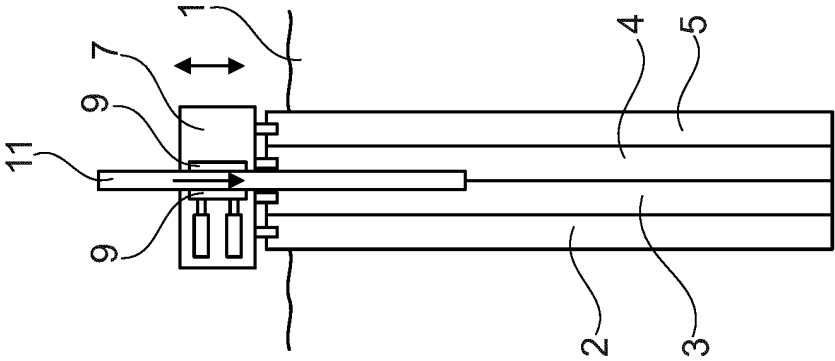
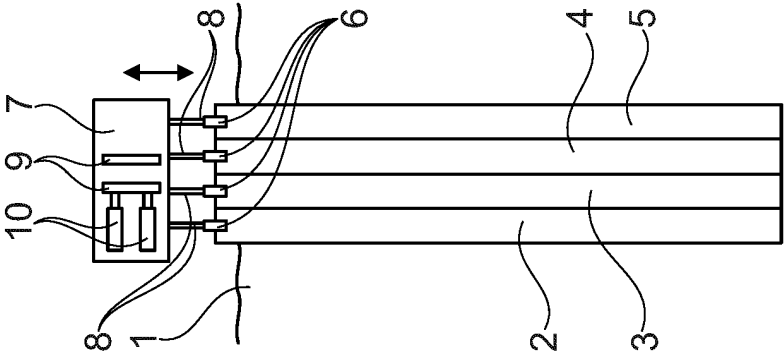
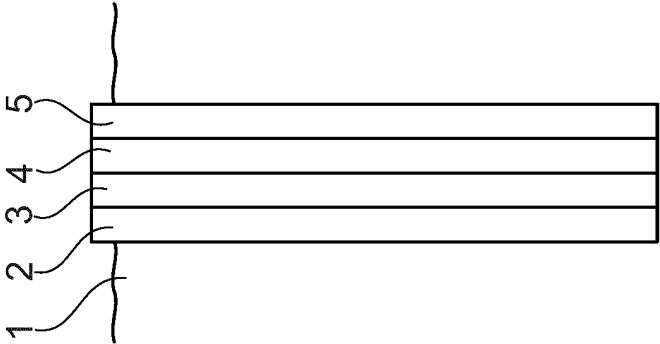
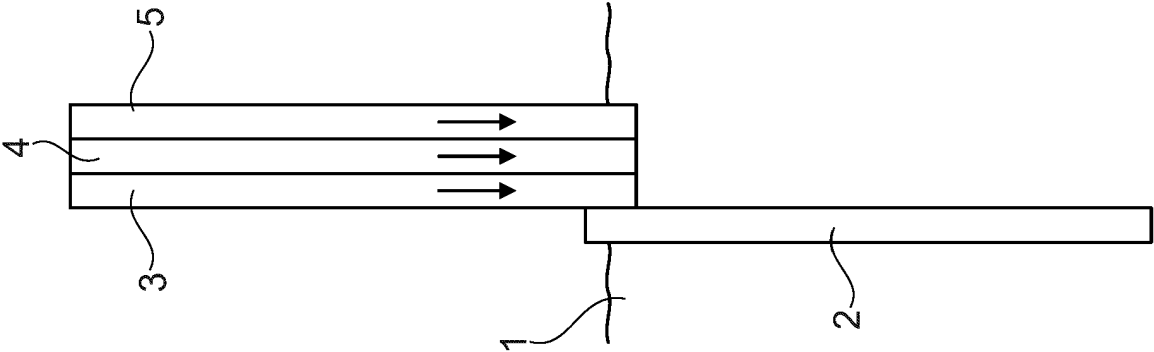
**gekennzeichnet durch:**

- eine Spannvorrichtung (9, 10) zum Einspannen eines Pfahls (11), beispielsweise eines Betonpfahls, wobei die Spannvorrichtung am anderen Ende des mindestens einen Presszylinders angeordnet ist.

6. Vorrichtung nach Anspruch 5, wobei die Befestigungsmittel zur Befestigung des Rahmens hydraulische Greifer an den Oberseiten von länglichen Platten umfassen, die in den Boden gedrückt werden, um den Rahmen an der Oberkante einer länglichen Platte einzuspannen. 5
7. Vorrichtung nach Anspruch 5 oder 6, wobei die Spannvorrichtung mindestens einen hydraulischen Greifer zum Umspannen eines Pfahls umfasst. 10
8. Vorrichtung nach einem der vorstehenden Ansprüche 5-7, wobei der Rahmen mindestens einen Querträger umfasst, wobei die Befestigungsmittel an beiden Enden des Querträgers angeordnet sind, wobei der Presszylinder entlang des Querträgers verschiebbar ist und auf diesem verschiebbar angeordnet ist. 15
9. Vorrichtung nach Anspruch 8, wobei der Rahmen weiter zwei parallele Längsträger umfasst, die in einem gegenseitigen Abstand angeordnet sind, wobei der mindestens eine Querträger auf den Längsträgern zum Gleiten in Längsrichtung der Längsträger angeordnet ist und wobei die Befestigungsmittel auf den Längsträgern angeordnet sind. 20 25

## Revendications

1. Procédé d'agencement d'un pieu, tel qu'un pieu en béton, dans le sol, lequel procédé comprend les étapes consistant à :
- agencer un certain nombre de plaques allongées (2-5) dans le sol une par une ;
  - agencer, sur les côtés supérieurs des plaques allongées enfoncées (8) dans le sol (1), un cadre (7) reliant (6) tous les côtés supérieurs entre eux ;
- caractérisé par :
- la fourniture d'un pieu (11), tel qu'un pieu en béton ;
  - l'enfoncement du pieu dans le sol, dans lequel la force d'enfoncement est générée entre le pieu et le cadre.
2. Procédé selon la revendication 1, dans lequel l'enfoncement du pieu dans le sol se déroule par étapes avec des courses d'enfoncement, dans lequel chaque course d'enfoncement comprend :
- le serrage du pieu par rapport au cadre à une position de début ;
  - l'enfoncement du pieu dans le sol sur une course déterminée ; et
- le relâchement du pieu à la fin de la course.
3. Procédé selon la revendication 1 ou 2, comprenant en outre l'étape de retrait des plaques allongées du sol une par une après que le pieu a été enfoncé dans le sol.
4. Procédé selon l'une quelconque des revendications précédentes, dans lequel les plaques allongées sont des plaques profilées en palplanches.
5. Dispositif adapté à la mise en œuvre d'un procédé selon l'une quelconque des revendications précédentes, lequel dispositif comprend :
- un cadre (7) avec des moyens de montage (6) pour monter le cadre sur les côtés supérieurs de plaques allongées (2-5) enfoncées dans le sol (1) ;
  - au moins un cylindre d'enfoncement (8) qui est agencé avec une extrémité sur le cadre ;
- caractérisé par :
- un dispositif de serrage (9, 10) pour serrer un pieu (11), tel qu'un pieu en béton, lequel dispositif de serrage est agencé sur l'autre extrémité du au moins un cylindre d'enfoncement.
6. Dispositif selon la revendication 5, dans lequel les moyens de montage pour monter le cadre comprennent des pinces hydrauliques sur les côtés supérieurs de plaques allongées enfoncées dans le sol dans le but de serrer le cadre sur le bord supérieur d'une plaque allongée.
7. Dispositif selon la revendication 5 ou 6, dans lequel le dispositif de serrage comprend au moins une pince hydraulique pour serrer autour d'un pieu.
8. Dispositif selon l'une quelconque des revendications précédentes 5-7, dans lequel le cadre comprend au moins une poutre transversale, dans lequel les moyens de montage sont agencés sur chaque extrémité de la poutre transversale, dans lequel le cylindre d'enfoncement peut coulisser le long de la poutre transversale et est agencé de manière coulissante sur celle-ci.
9. Dispositif selon la revendication 8, dans lequel le cadre comprend en outre deux poutres longitudinales parallèles agencées à une distance mutuelle, dans lequel la au moins une poutre transversale est agencée sur les poutres longitudinales pour coulisser dans la direction longitudinale des poutres longitudinales et dans lequel les moyens de montage sont agencés sur les poutres longitudinales.



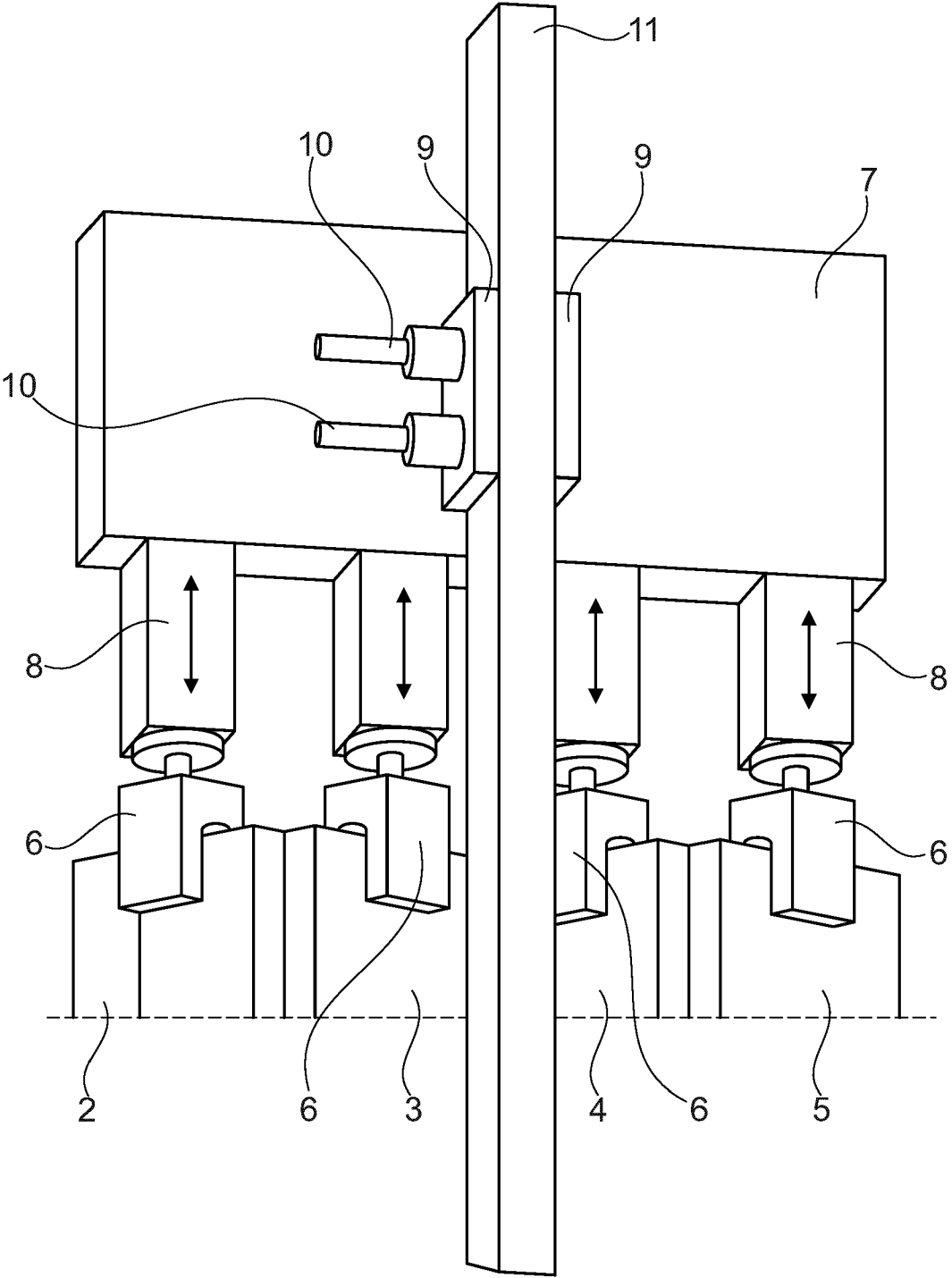


Fig. 2

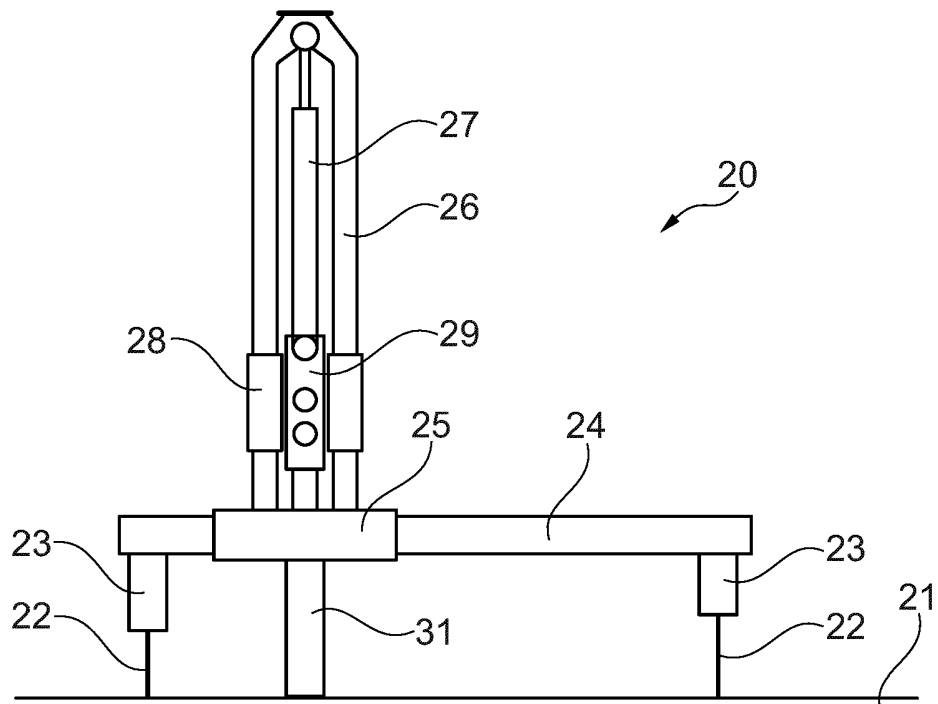


Fig. 3

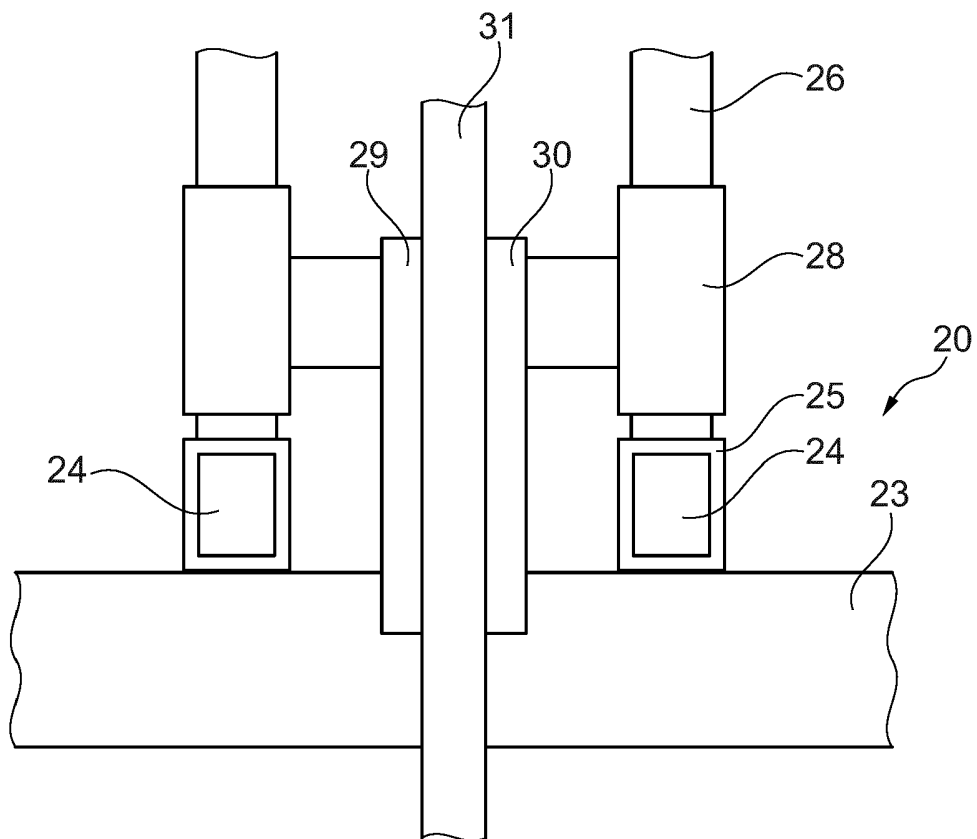


Fig. 4



**REFERENCES CITED IN THE DESCRIPTION**

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- EP 1806455 A [0007]
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