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(54) Title: APPARATUS FOR DRIVING ELONGATED ELEMENTS INTO THE GROUND

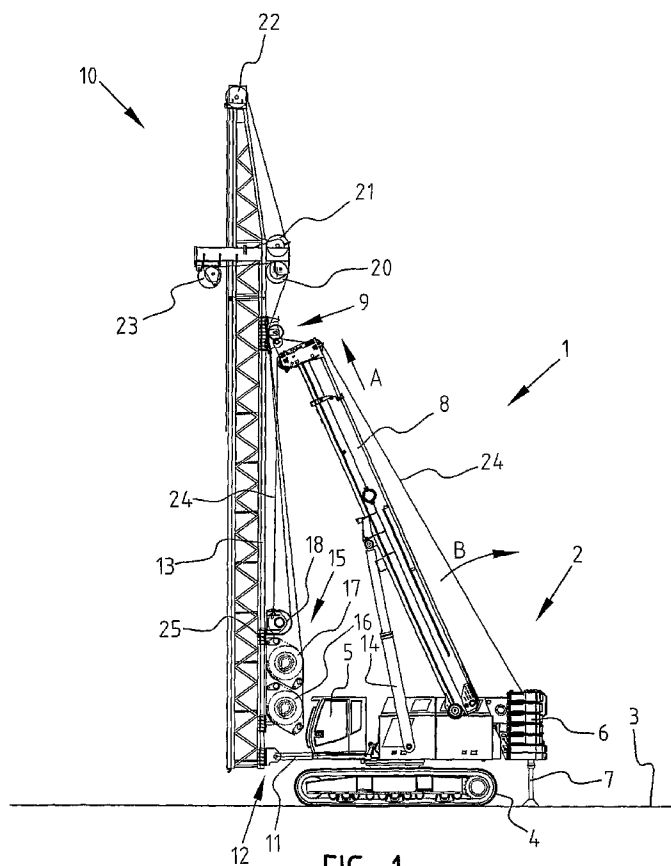


FIG. 1

(57) Abstract: The invention relates to an apparatus for driving elongate elements such as piles, drilling elements etc. into the ground, comprising a displaceable frame (2), an elongate guide (13), at least one coupling (9, 12) with which at least during use the frame and the elongate guide are coupled, pushing means with which the elongate elements are driven into the ground, which pushing means are displaceable along the elongate guide, and a drive with (15) which the pushing means can be displaced along the elongate guide.



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**APPARATUS FOR DRIVING ELONGATED ELEMENTS INTO THE GROUND**

The invention relates to an apparatus for driving elongate elements such as piles, drilling elements etc. into the ground, comprising a displaceable frame, an elongate guide, at least one coupling with which at least during use the frame and the elongate guide are coupled, pushing means with which the elongate elements are driven into the ground, which pushing means are displaceable along the elongate guide, and a drive with which the pushing means can be displaced along the elongate guide.

Such apparatuses are known, for instance for driving into the ground piles which serve as foundation of for instance buildings. These so-called pile drivers are generally large machines with a long, elongate guide in the form of a pile-driving mast, and a heavy and large frame for stable support of the pile-driving mast in the position of use thereof. As a result of, among other factors, the size of the pile-driving mast and the frame, the transport of such machines and the erection thereof at the construction site are complex operations which take up a lot of time. In addition, the known pile drivers are generally only suitable for a specific type of pile-driving work. Particularly at a construction site where multiple types of pile-driving work must be carried out different pile drivers are therefore necessary, each of which must be transported to the construction site and erected. It is important here that a pile driver can be utilized in the most versatile possible way.

The utility of the known pile drivers is limited by, among other factors, the drive which serves to displace the pushing means along the elongate guide, such as for instance a pile hammer with which a pile is

driven into the ground. Such a drive, for instance in the form of a winch gear, is generally sizable and has a considerable weight. In order to reduce the influence on the elongate guide of the forces occurring when the  
5 piles are driven into the ground, it is known to arrange the drive on the elongate guide. The weight of the drive gives the elongate guide extra stability. A drawback of arranging the drive on the elongate guide is however that, as a result of the size of the drive, it is for  
10 instance not possible to lower the elongate guide into a narrow pit in order to drive a pile into the ground at the bottom thereof. When the elongate guide is lowered into the hole the drive then for instance becomes jammed against the frame of the apparatus or against the edge  
15 of the pit. In such a case a pile driver specifically suitable for this purpose is then required. Another drawback of arranging the drive on the elongate guide occurs in the case that the elongate guide must be moved upward. The drive will in this case, when moved upward,  
20 for instance become jammed against the coupling, located thereabove, of the elongate guide with the frame. It is also possible that the apparatus becomes unstable due to the upward displacement of the weight of the drive. A pile driver specifically suitable for this purpose is  
25 also required in such a case.

The invention has for its object to obviate or at least alleviate the drawbacks of the existing apparatus and thereby increase the utility of such apparatus. To this end the invention is distinguished in that the  
30 drive is displaceable along the elongate guide. This measure makes it for instance possible to lower the elongate guide into a pit while the drive remains positioned above the pit. In addition, this measure makes it possible to hold or place the drive at the  
35 desired position when the elongate guide is moved

upward. This measure thus has the advantage that no special pile driver need be utilized when downward or upward displacement of the elongate guide relative to the frame is desired.

5        In an additional embodiment of the apparatus according to the invention the elongate guide comprises a drive guide along which the drive is displaceable. This measure has the advantage that the drive can be displaced in rapid and simple manner along the elongate  
10 guide without having to be removed from the elongate guide.

      In an additional embodiment of the apparatus according to the invention the drive is displaceable along the elongate guide by means of a displacement  
15 drive. This measure enables a simple and rapid displacement of the drive along the elongate guide. The apparatus can thus be quickly adapted to a situation of use. In an additional embodiment thereof, the drive comprises the displacement drive. This measure forms a  
20 simple and compact implementation of the displacement drive.

      In an additional embodiment of the apparatus according to the invention the elongate guide can be extended. This measure makes it possible to adjust the  
25 apparatus to for instance the depth of a pit or the length of a pile. This has the advantage that the apparatus can be utilized in multiple situations of use. In an additional embodiment hereof the elongate guide can be extended by means of extension elements which can  
30 be coupled thereto. Using these extension elements it is for instance possible to extend the elongate guide from the bottom, while it is coupled to the frame, by moving the elongate guide upward and subsequently placing an extension element thereunder and coupling it to the  
35 elongate guide. This measure makes it possible in simple

and rapid manner to extend and adjust the elongate guide to the situation of use without the elongate guide having to be uncoupled from the frame. Because the drive is displaceable along the elongate guide, the drive can  
5 be held or placed at the desired position along the elongate guide when the elongate guide is extended, for instance in order to improve the stability of the extended elongate guide.

In an additional embodiment of the apparatus  
10 according to the invention the frame comprises at least one arm which supports the at least one coupling. In an additional embodiment hereof the length of the arm is adjustable. This measure makes it possible for instance to adjust the position of the coupling supported by the  
15 arm, and thereby the orientation of the elongate guide relative to the frame, to the situation of use. In an additional embodiment hereof, the length of the arm can be adjusted by means of a longitudinal drive. This measure enables a rapid and simple extension of the arm.  
20 In an additional or alternative embodiment hereof, the angular position of the arm is adjustable. This measure makes it possible for instance to adjust the position of the coupling supported by the arm, and thereby the orientation of the elongate guide relative to the frame,  
25 to the situation of use. In an additional embodiment hereof the angular position of the arm relative to the frame can be adjusted by means of an angular position drive. This measure enables a rapid and simple adjustment of the angular position of the arm.

30 In an additional embodiment of the apparatus according to the invention with at least one arm, the arm comprises lifting means. This measure makes it possible to use the frame for the purpose of moving the elongate guide uncoupled therefrom and the necessary  
35 extension elements to the desired position before the

apparatus is moved into a position of use. This measure thus has the advantage that no extra lifting machines are necessary.

In an additional embodiment of the apparatus according to the invention the at least one coupling is displaceable along the elongate guide. This measure makes it possible for instance to adjust the position at which the coupling engages on the elongate guide when the elongate guide is moved upward or downward. This has the advantage for instance that an arm of the same length can be used for a longer elongate guide, and that the length of the arm does not have to be adjusted when the elongate guide is extended. In an additional embodiment hereof the elongate guide comprises a coupling guide along which the coupling is displaceable. This measure enables rapid and simple adjustment of the position at which the coupling engages on the elongate guide, without removal of the coupling from the elongate guide.

In an additional embodiment of the apparatus according to the invention with drive guide and coupling guide, the drive guide and the coupling guide are a unit. This measure enables a simple embodiment of the two guides.

In an additional embodiment of the apparatus according to the invention with the at least one displaceable coupling, the at least one coupling is displaceable along the elongate guide by means of a coupling drive. This measure enables a rapid, simple displacement of the coupling along the elongate guide, or displacement of the elongate guide along the coupling. In an additional embodiment hereof the drive comprises the coupling drive. In an alternative embodiment hereof the lifting means comprise the coupling drive.

The invention also relates to an apparatus for driving elongate elements, such as piles, drilling elements etc., into the ground, comprising a displaceable frame, an elongate guide, at least one coupling with which at least during use the frame and the elongate guide are coupled, pushing means with which the elongate elements are driven into the ground, which pushing means are displaceable along the elongate guide, wherein the elongate guide is disposed on a front side of the frame, and the apparatus comprises adjusting means with which the elongate guide is displaceable relative to the frame in a plane perpendicularly of the forward direction of the frame associated with the front side. This measure makes it possible to utilize the apparatus at locations where the frame, as a result of the dimensions in the forward direction thereof, cannot be positioned such that the desired orientation of the pile in the ground can be realized. In an additional embodiment hereof the displacement of the elongate guide comprises a translation. In a further additional or alternative embodiment hereof, the displacement of the elongate guide comprises a rotation. This measure makes it possible to drive piles into the ground at an angle adjacently of the elongate guide.

In an additional embodiment of the apparatus according to the invention, wherein the elongate guide is displaceable relative to the frame in a plane perpendicularly of the forward direction of the frame associated with the front side, the adjusting means act on the at least one coupling. In an additional embodiment hereof the at least one coupling can be displaced by means of the adjusting means in the plane perpendicularly of the forward direction of the frame associated with the front side.



The present invention will be further elucidated hereinbelow on the basis of an exemplary embodiment which is shown schematically in the accompanying figures. This is a non-limitative exemplary embodiment.

5 In the figures:

- figure 1 shows a side view of the apparatus according to the invention,
- figure 2 shows a side view of the apparatus of figure 1 during extending of the elongate guide,
- 10 - figure 3 shows a side view of the apparatus of figure 1 after the elongate guide has been extended,
- figure 4 shows a side view of the apparatus according to the invention with extended, elongate guide in the situation of use,
- 15 - figure 5 shows a front view of the apparatus of figure 4,
- figure 6 shows a side view of the apparatus of figure 1 before placing of the elongate guide in a vertical orientation,
- 20 - figure 7 shows a side view of the apparatus of figure 1 during placing of the elongate guide in a vertical orientation.

Figure 1 shows an apparatus 1 with a frame 2, which is displaceable over the ground 3 using caterpillar  
25 tracks 4. On the front side thereof the frame has a driver's cab 5. At the rear the frame 2 has a ballast 6 and support jack 7, which prevent apparatus 1 tilting forward and rearward. Frame 2 has a first arm 8 which is coupled by means of an upper coupling 9 to an elongate  
30 guide in the form of a pile-driving mast 10, and a second arm 11 which is coupled by means of a lower coupling 12 to pile-driving mast 10. Upper coupling 9 and lower coupling 12 engage on and are displaceable along a coupling guide in the form of guide rail 13.  
35 First arm 8 is length-adjustable by means of a

longitudinal drive (not shown) and for this purpose can be extended like a telescope from the shown position in the direction of arrow A. The angular position of arm 8 can be adjusted by means of the angular position drive embodied as lifting cylinder 14. An extension of lifting cylinder 14 results for instance in a rotation of arm 8 in the direction of arrow B.

Arranged on pile-driving mast 10 is a drive in the form of a winch gear 15 which engages on and is slidable along the drive guide in the form of guide rail 13. Winch gear 15 is displaceable along pile-driving mast 10 by means of a displacement drive embodied as lifting cable 24 and the lifting winch located in frame 2. Winch gear 15 is shown with two pile-driving winches 16 and 17 and auxiliary winch 18, with which a pushing means (not shown), such as for instance a pile-driving hammer, can be driven via cable bundle 19 and pulleys 20, 21, 22 and 23. Auxiliary winch 18 can be used as alternative displacement drive.

The displacement of winch gear 15 along pile-driving mast 10 can be blocked by means of blocking mechanism 25. By blocking the displacement of winch gear 15 and simultaneously taking in lifting cable 24 by means of the lifting winch situated in frame 2, pile-driving mast 10 can be moved upward relative to the frame to allow for instance extending of the pile-driving mast.

Figures 2 and 3 show the extending of pile-driving mast 10 of apparatus 1 of figure 1. In figure 2 the upper coupling 9 is moved upward by extending arm 8 and increasing the angle of arm 8 relative to the situation as shown in figure 1. By blocking the displacement of winch gear 15 by means of blocking mechanism 25 during the upward movement of this coupling, pile-driving mast 10 and lower coupling 12 are herein also moved upward,

and second arm 11 is extended. It has hereby become possible to couple extension element 26 to pile-driving mast 10 and place it in line with pile-driving mast 10 in the direction of arrow C, whereby extension element 26 is integrated with pile-driving mast 10. By then lowering lower coupling 12 along pile-driving mast 10 while pile-driving mast 10 supports on the ground 3, terminating the blocking of winch gear 15, shortening arm 8 and reducing the angle of arm 8, the upper coupling 6 and winch gear 15 are lowered along pile-driving mast 10. This brings about the situation as shown in figure 3. By blocking winch gear 15, extending arm 8 and increasing the angle of arm 8 it is then possible to move upper coupling 9, and thereby pile-driving mast 10, upward from this situation and subsequently extend the mast using a following extension element. It is thus possible to realize the situation as shown in figure 4, in which apparatus 1 is shown with pile-driving mast 7 which is extended by means of extension elements 26, 27, 28 and 29. Figure 4 also shows that the lower pile-driving winch 16 of winch gear 15 is displaced in the direction of arrow D in order to release pile-driving cable 19a of cable bundle 19 from pile-driving cable 19b of pile-driving winch 17. The pushing means in the form of pile-driving hammer 30 can thus be driven. Apparatus 1 is then in the position of use.

Figure 5 shows apparatus 1 of figure 4 with frame 2 and pile-driving mast 10, which is shown in three positions a, b and c in which pile-driving mast 10 can be oriented. Pile-driving mast 10 is connected to frame 2 by means of upper coupling 9 and lower coupling 12. Upper coupling 9 couples pile-driving mast 10 to arm 8 (not shown). Lower coupling 12 is connected to adjusting means embodied as displacing table 31. Position b and

then position c of pile-driving mast 10 is realized by displacing lower coupling 9 from the position a of pile-driving mast 10 in the direction of arrow E.

In position a of pile-driving mast 10 it is for instance possible to drive a pile (not shown) into the ground 3 in the direction of arrow F.

Figure 6 shows apparatus 1 of figure 1 before pile-driving mast 10 is moved into vertical orientation. Shown is that pile-driving mast 10 can be lifted from the ground 3 and displaced over the ground 3 by means of frame 2 by means of the lifting means in the form of the hoisting winch situated in frame 2, lifting cable 24 and lifting hook 32.

Figure 7 shows apparatus 1 of figure 1 during placing of pile-driving mast 10 in the vertical orientation. By shortening the arm 8 in the direction of arrow G from the shown situation, and simultaneously increasing the angle of arm 8 in the direction of arrow H, pile-driving mast 10 rotates in the direction of arrow I, whereby the situation as shown in figure 1 can be realized.

In figure 1 the pile-driving mast is coupled to the frame by means of two couplings. There can also be more or fewer couplings. It is for instance possible for the pile-driving mast to be coupled to the frame only with the upper coupling.

Figure 1 shows the winch gear on the rear side of the pile-driving mast. The winch gear can however also be arranged on the front side or another side of the pile-driving mast.

In figure 1 the winch gear is shown as displaceable by means of winches and cables. The displacement of the winch gear along the pile-driving mast can for instance also take place by means of a gear rack system.

Figure 1 shows the upper coupling as freely displaceable along the pile-driving mast. The upper coupling can also be provided with a blocking mechanism or with a coupling drive such as a gear rack system. The pile-driving mast can then for instance be moved upward by holding the upper coupling at one position and displacing the pile-driving mast along the coupling by means of this coupling drive.

Figure 1 shows the frame on caterpillar tracks. The frame can for instance also have wheels, or the frame can for instance be a floating pontoon.

In figure 1 the length of the first arm and the angular position thereof is adjustable. The first arm can for instance be non-adjustable.

Figure 1 shows the winch gear with three winches. It is also possible for more or fewer winches to be provided. An extra winch can for instance be arranged, which can be used to enable displacement of the winch gear along the pile-driving mast when displacement using gravity is not possible due to a horizontal orientation of the pile-driving mast.

In figure 2 the pile-driving mast is extensible by means of extension elements. The pile-driving mast can however also be telescopically extensible.

Figure 4 shows the pile-driving mast in vertical orientation. By for instance increasing the angle of the first arm, the pile-driving mast tilts rearward and a pile can be driven obliquely into the ground.

In figure 5 the adjusting means act on the lower coupling. The adjusting means can for instance also act on the upper coupling. The lower coupling can for instance be omitted here.

Figure 5 shows the pile-driving mast in three positions. Any position lying between the shown positions is however possible.

In figure 5 the shown positions comprise a rotation of the pile-driving mast in the plane of the drawing. A translation in the plane of the drawing is for instance also possible when the upper coupling is for instance also arranged on a displacing table.

The measure of arranging the drive on the elongate guide also has the advantage that the cables of the drive need not be removed from the elongate guide when the elongate guide is uncoupled from the frame.

Figure 1 shows various pulleys on the elongate guide, including pulley 22 at the upper end of the elongate guide and pulley 23 at an end of an arm arranged transversely of the elongate guide. These pulleys at different locations on the elongate guide make it possible to apply the elongate guide in combination with different pushing means and different types of elongate element.

**CLAIMS**

1. Apparatus for driving elongate elements such as piles, drilling elements etc. into the ground,  
5 comprising:  
- a displaceable frame;  
- an elongate guide;  
- at least one coupling with which at least during use the frame and the elongate guide are coupled;  
10 - pushing means with which the elongate elements are driven into the ground, which pushing means are displaceable along the elongate guide; and  
- a drive with which the pushing means can be displaced along the elongate guide;  
15 characterized in that  
- the drive is arranged on the elongate guide; and  
- the drive is displaceable along the elongate guide.
2. Apparatus as claimed in claim 1,  
characterized in that  
20 the elongate guide comprises a drive guide along which the drive is displaceable.
3. Apparatus as claimed in claim 1 or 2,  
characterized in that  
the drive is displaceable along the elongate guide by  
25 means of a displacement drive.
4. Apparatus as claimed in claim 3,  
characterized in that  
the drive comprises the displacement drive.
5. Apparatus as claimed in any of the foregoing  
30 claims,  
characterized in that  
the elongate guide can be extended in vertical orientation.
6. Apparatus as claimed in claim 5,  
35 characterized in that

the elongate guide can be extended by means of extension elements which can be coupled thereto.

7. Apparatus as claimed in any of the foregoing claims,

5 characterized in that

the frame comprises at least one arm which supports the at least one coupling.

8. Apparatus as claimed in claim 7, characterized in that

10 the length of the arm is adjustable.

9. Apparatus as claimed in claim 8, characterized in that

the length of the arm can be adjusted by means of a longitudinal drive.

15 10. Apparatus as claimed in any of the claims 7-9, characterized in that

the angular position of the arm is adjustable.

11. Apparatus as claimed in claim 10, characterized in that

20 the angular position of the arm can be adjusted by means of an angular position drive.

12. Apparatus as claimed in any of the claims 7-11, characterized in that

the arm comprises lifting means.

25 13. Apparatus as claimed in any of the foregoing claims,

characterized in that

the at least one coupling is displaceable along the elongate guide.

30 14. Apparatus as claimed in claim 13, characterized in that

the elongate guide comprises a coupling guide along which the at least one coupling is displaceable.

15. Apparatus as claimed in at least claims 2 and  
35 14,



characterized in that  
the drive guide and the coupling guide are a unit.

16. Apparatus as claimed in any of the claims 13-  
15,

5 characterized in that  
the at least one coupling is displaceable along the  
elongate guide by means of a coupling drive.

17. Apparatus as claimed in claim 16,  
characterized in that  
10 the drive comprises the coupling drive.

18. Apparatus as claimed in at least claims 12 and  
16,

characterized in that  
the lifting means comprise the coupling drive.

15 19. Apparatus for driving elongate elements, such  
as piles, drilling elements etc., into the ground,  
comprising:

- a displaceable frame;
- an elongate guide;

20 - at least one coupling with which at least during use  
the frame and the elongate guide are coupled;  
- pushing means with which the elongate elements are  
driven into the ground, which pushing means are  
displaceable along the elongate guide;

25 characterized in that  
the elongate guide is disposed on a front side of the  
frame, and the apparatus comprises adjusting means with  
which the elongate guide is displaceable relative to the  
frame in a plane perpendicularly of the forward  
30 direction of the frame associated with the front side.

20. Apparatus as claimed in claim 19,  
characterized in that  
the displacement of the elongate guide comprises a  
translation.

21. Apparatus as claimed in any of the claims 19  
and 20,  
characterized in that  
the displacement of the elongate guide comprises a  
5 rotation.

22. Apparatus as claimed in any of the claims 19-  
21,  
characterized in that  
the adjusting means act on the at least one coupling.

10 23. Apparatus as claimed in claim 22,  
characterized in that  
the at least one coupling can be displaced by means of  
the adjusting means in the plane perpendicularly of the  
forward direction of the frame associated with the front  
15 side.

24. Method for placing into a position of use an  
apparatus for driving elongate elements such as piles,  
drilling elements etc. into the ground, comprising the  
steps of:  
20 - providing a frame;  
- providing an elongate guide with a drive thereon with  
which pushing means can be displaced along the elongate  
guide;  
- coupling the elongate guide to the frame;  
25 - placing the elongate guide into a vertical  
orientation; and  
- displacing the drive along the elongate guide.

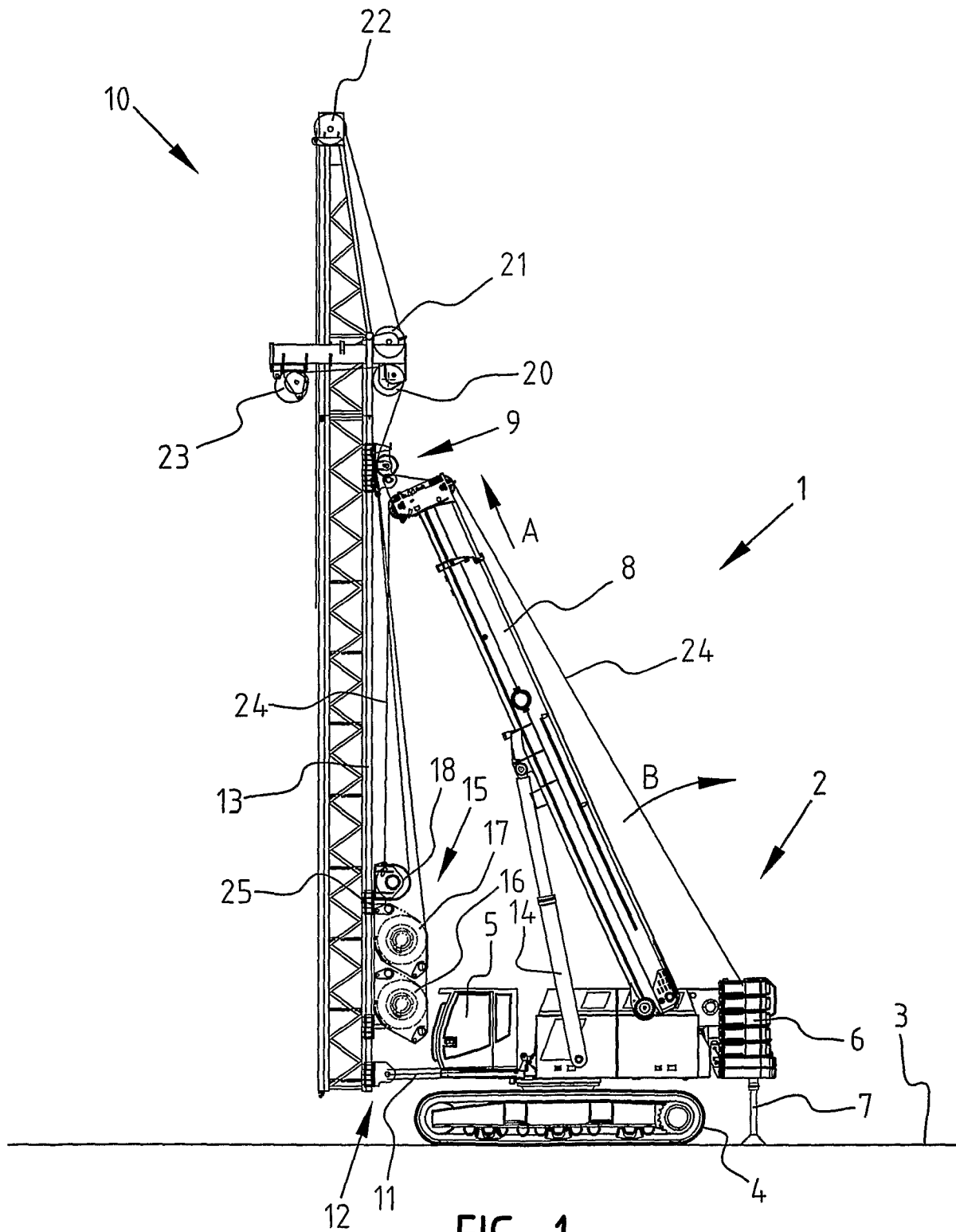
25. Method as claimed in claim 24,  
characterized by  
30 the step of displacing the elongate guide relative to  
the frame after the step of placing thereof in a  
vertical orientation.

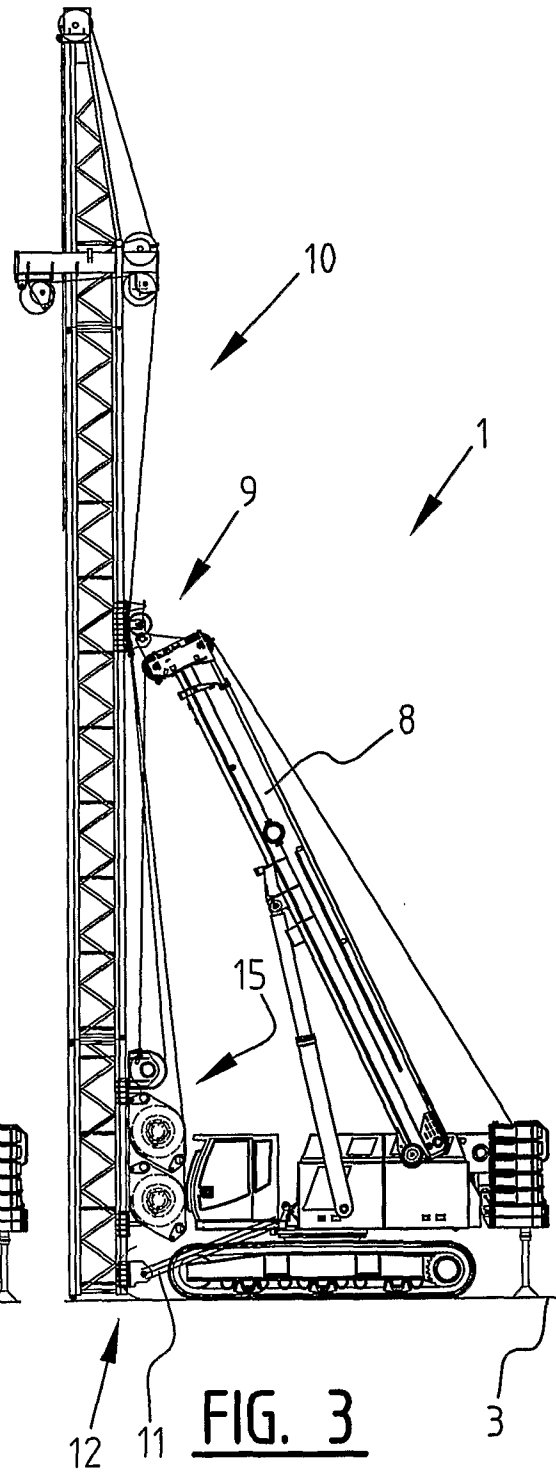
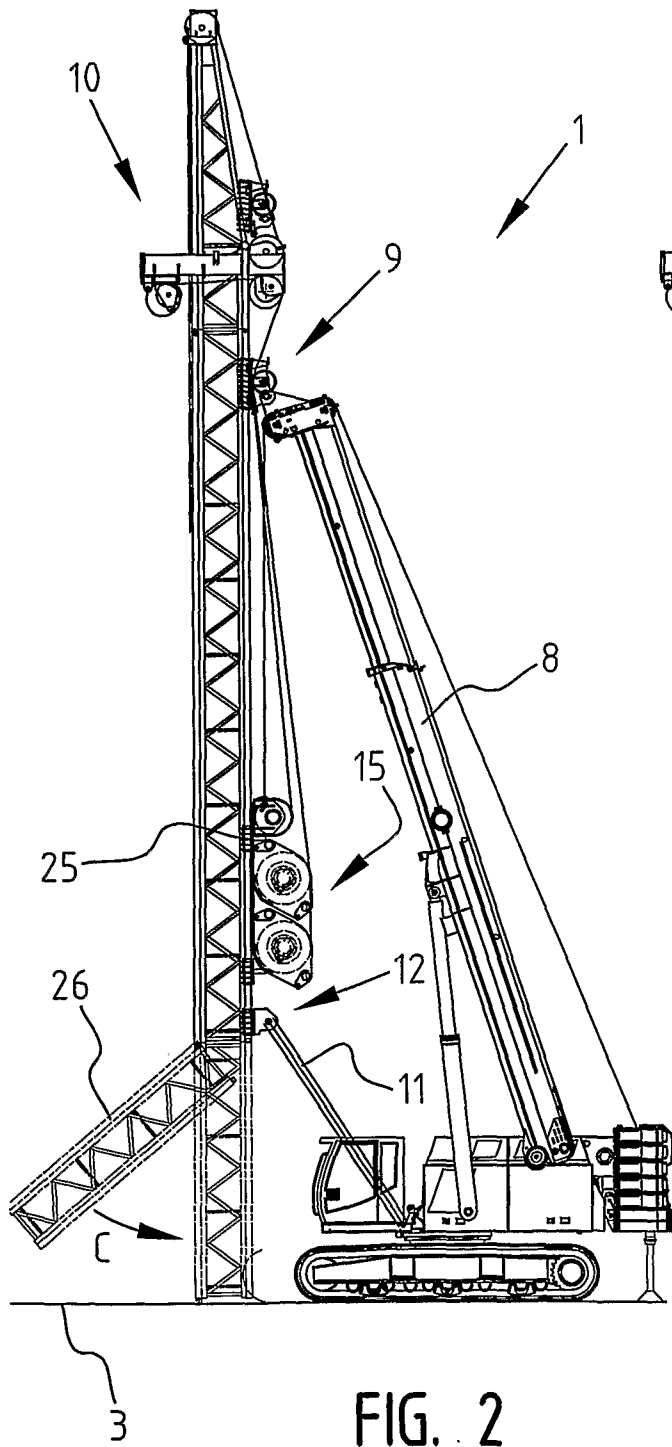
26. Method as claimed in any of the claims 24 and  
25,  
35 characterized by

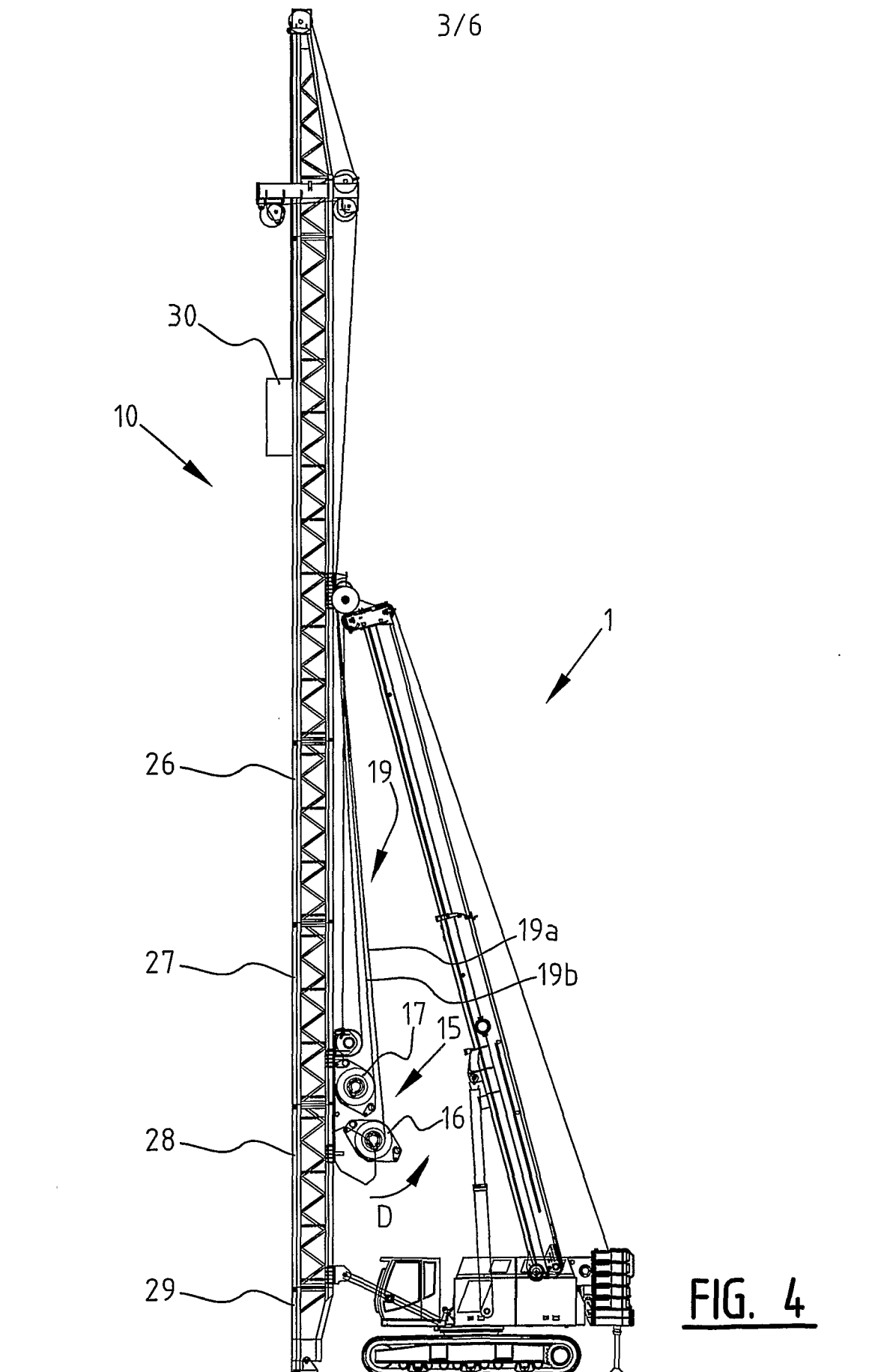
the step of extending the elongate guide after the step of placing thereof in a vertical orientation, comprising the steps of:

- displacing the elongate guide upward relative to the  
5 frame;
- coupling an extension element to the underside of the elongate guide so that it forms a unit with the elongate guide.

1/6

FIG. 1





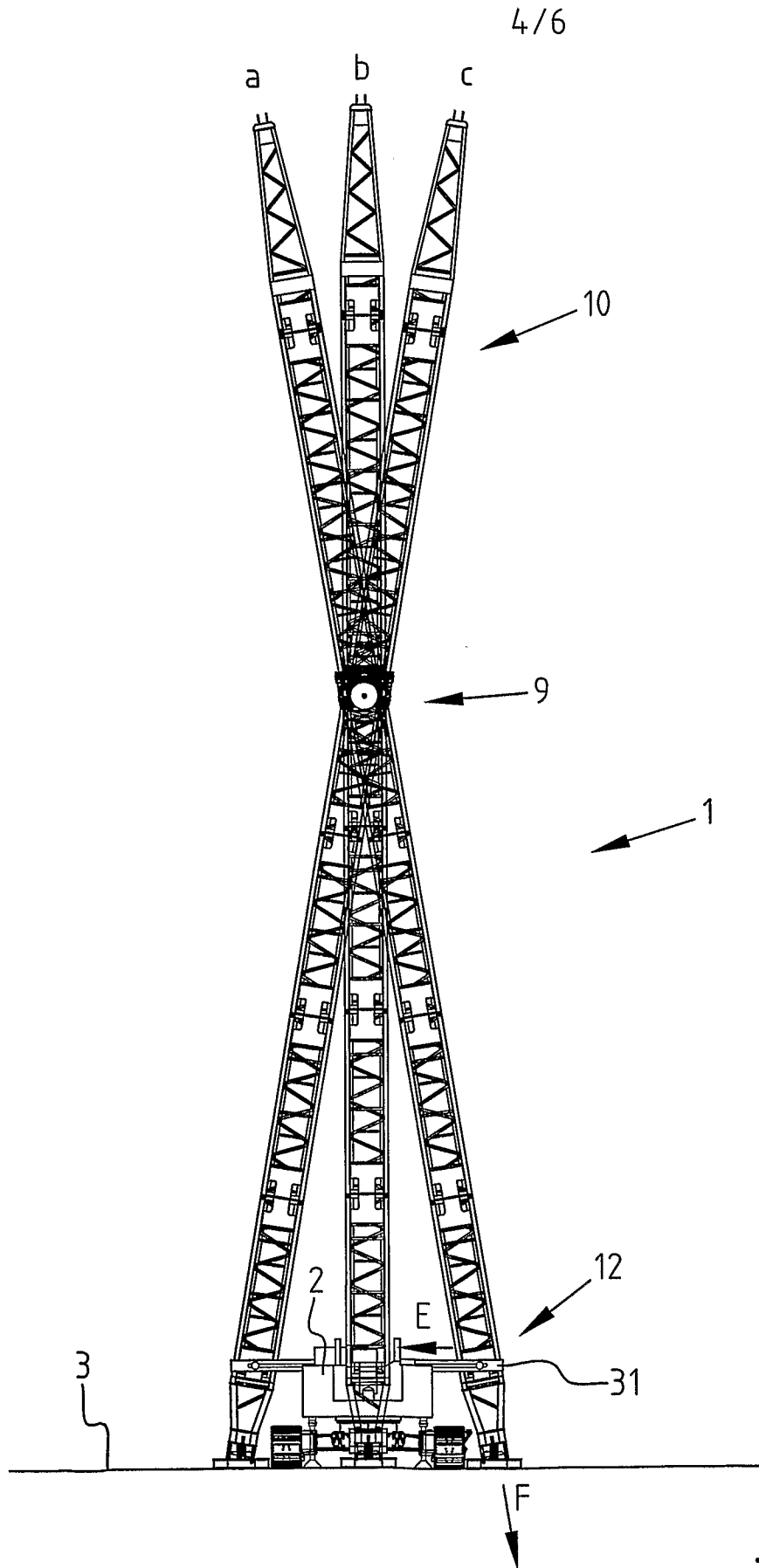


FIG. 5

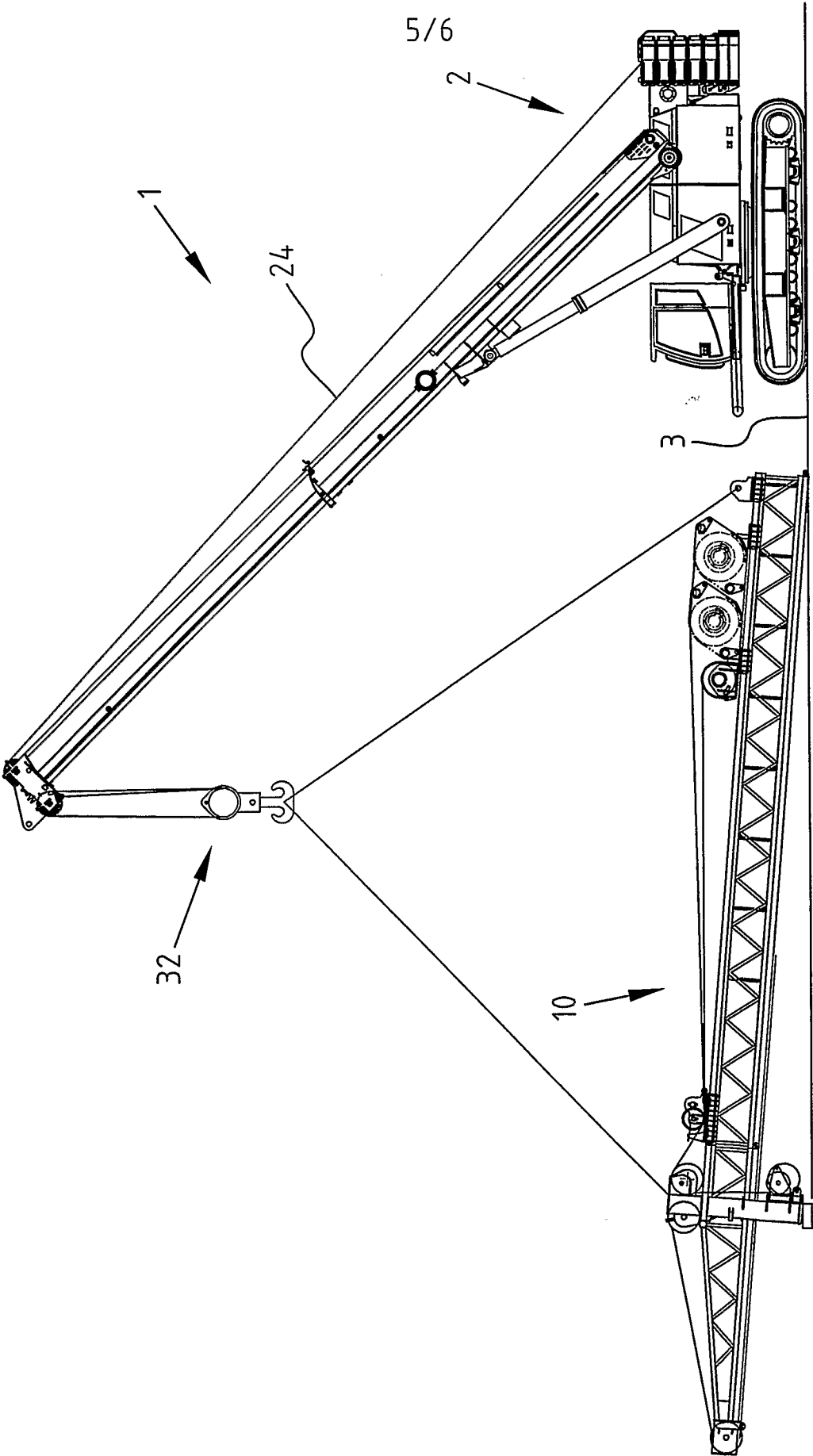


FIG. 6



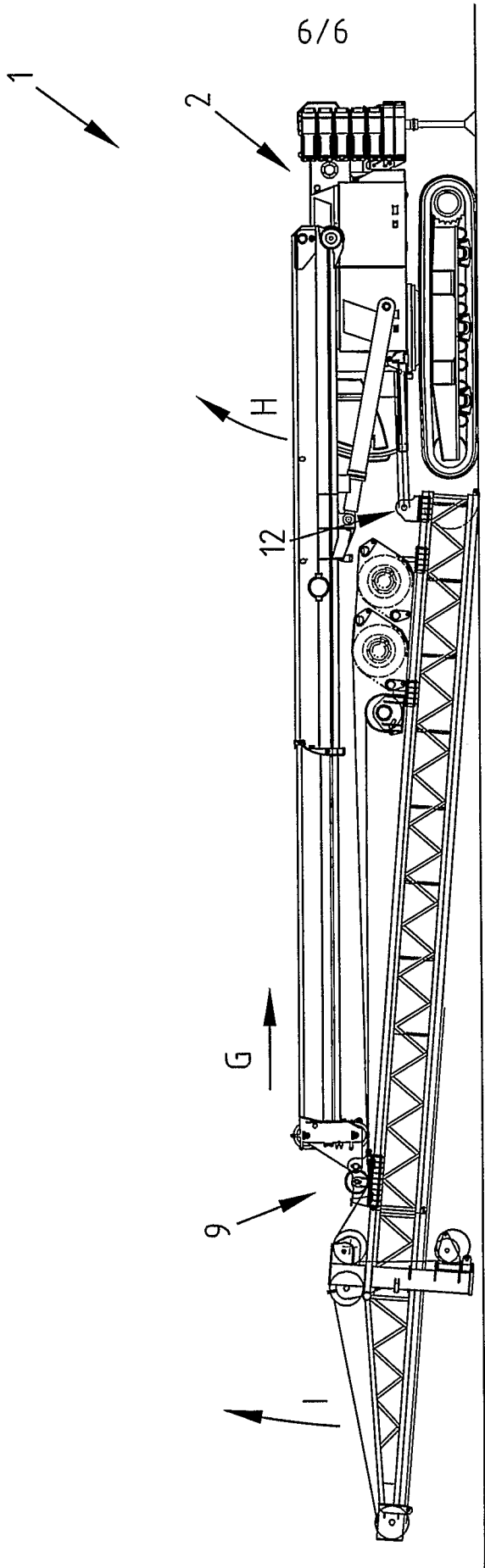


FIG. 7

## INTERNATIONAL SEARCH REPORT

International application No

PCT/NL2008/000051

## A. CLASSIFICATION OF SUBJECT MATTER

INV. E02D7/16 E02D7/20 E02D7/08 E21B7/02 E21B15/00

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E02D E21B

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

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

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 827 508 A (MAC KINNON A) 6 August 1974 (1974-08-06)	1-4,7-18
Y	column 2, line 12 - column 3, line 2; figure 1	5,6
Y	GB 2 060 742 A (SANWA KIZAI CO LTD) 7 May 1981 (1981-05-07) figure 1	5,6
X	US 2 134 989 A (TEMPLETON JOHN B) 1 November 1938 (1938-11-01) figures 1,2,2a page 1, column 2, line 20 - page 2, column 1, line 65  ----- -/--	19,21,22

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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