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(54) **nydraulic drilling machine of telescopic tower type**

Hydraulische Bohrmaschine mit teleskopierbarem Turm

Machine à forer hydraulique du type à tour télescopique

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Description

This invention falls within the field of drilling rigs, and more particularly relates to a hydraulic drilling machine of telescopic tower type with a system for stowing and handling the drill rods.

In earth drilling, various types of drilling machines are known mounted for transportation on a truck or on a trailer or half trailer and provided with independent motive power units for rotating a cutting tool to form a hole, or enlarge a hole previously formed, in the ground.

A drilling machine of conventional type comprises a tower mounted on the transporting vehicle. During transportation the tower is laid horizontally on the transporting vehicle and is raised to a vertical position by hydraulic pistons or mechanical systems for normal operation.

Various auxiliary devices such as an air compressor, mud pump, handling and service winches etc. are also usually mounted on the transporting vehicle.

The driving head, to which the drill rods are fixed in a length determined by the tower height, is normally slidingly mounted on the tower.

To reduce the downtime required for joining the rods together during drilling, it is clearly advantageous to use a drilling rig which enables the longest possible rods to be utilized.

The main problem relating to such drilling machines regards their transport. In this respect, when a very tall tower is laid down on the transporting vehicle, serious size and manoeuvrability problems arise, with the possibility of it extending beyond the transport size limitations imposed by local laws.

An object of the invention is to provide a hydraulic drilling machine comprising a tower which enables long rods to be used while at the same time lying within the overall outline of the transporting vehicle.

During drilling and rod recovery, the rods are contained in a well immediately adjacent to the borehole, to be taken up (or deposited) one by one by the driving head.

Hence for each rod the driving head has to be moved from its position vertically above the borehole to a position above said well to enable it to take up or return a rod.

A further object of the invention is to provide a drilling machine comprising a simple and functional device for moving the driving head to enable it to take up and/or deposit the individual drill rods when necessary.

A further object of the present invention is to provide a drilling machine in which the loads acting on the tower are arranged as symmetrically as possible about the tower axis in order to reduce bending stresses to a minimum.

US-A-4 020 909 discloses a drilling machine which represents the prior art as referred to in the precharacterising portion of claim 1.

The above and further objects and advantages, which will be more apparent hereinafter, are attained according to the invention by a drilling machine of the type comprising a drilling tower fixed in a reclinable manner on a transporting vehicle and provided with motive power units and a driving head for driving the drill rods, the drilling tower being of telescopic type slidable along a fixed guide structure or lattice by the action of a hydraulic piston, the telescopic tower being provided at its ends with a series of pulleys to allow the movement of flexible transmission means having one end connected to said driving head and the other end connected to a point on the fixed structure, so as to form a closed ring about the tower; characterised in that the driving head is connected via an articulated quadrilateral linkage to a rigid frame slidable on the telescopic tower, said quadrilateral linkage consisting of two rigid arms pivotally connected to the frame and to the head and a hydraulic piston means pivotally connected to the frame and to one of said rigid arms, such that operation of said piston means causes the head to undergo a rotation-translation movement.

A preferred but not-limiting embodiment of the drilling machine according to the invention is described hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a side view of the drilling machine according to the invention in its operating position;
Figure 2 is a side view of the drilling machine in its transporting position;
Figure 3 is a schematic view of a detail of the drilling machine to an enlarged scale:
Pigure 4 is a side view of a further detail of the machine according to the invention to an enlarged scale; and
Figure is a horizontal section on the line V-V of Pigure 1 to an enlarged scale.

At various points in the following description, reference is made for simplicity to single elements which are in fact double, in that the accompanying drawings are mostly side views rather than perspective views, so that their depth is not shown.

On this basis, with reference to Figures 1 and 2 a drilling machine according to the invention comprises a drilling rig indicated overall by 10, securely hinged at 12 to the rear of a transporting vehicle 11 in which a diesel engine 17 and other auxiliary devices such as a mud pump or compressor 16, an independent motive power unit 15 and a handling winch 14 are mounted. The drilling rig 10 can be laid down nearly horizontally by rotating it in a vertical plane by means of hydraulic pistons 13. When in this transporting position, shown in Pigure 2. the rig 10 rests at its front on a suitable frame 18 of the transporting vehicle 11 and completely lies within the overall outline of the vehicle.

With reference to Figure 1, the drilling machine comprises a series of hydraulic jacks 19 and mechanical screw jacks 20 to ensure that the drilling rig 10 is stable

and vertical.

According to the invention, a telescopic tower 22 (Figures 3 and 5) of rectangular cross-section comprises in its interior a tubular hydraulic piston 23 of height virtually equal to that of the tower 22.

According to the invention, the tower 22 is able to slide within a support structure or lattice 24 when raised by the piston 23.

To facilitate sliding of the tower 22 within the lattice 24, a series of rollers 21 are provided interposed between mutually facing guides 25 and 26 rigid with the tower 22 and with the lattice 24 respectively (Figure 5). To achieve the same purpose other equivalent mechanical means can be used instead, such as guide systems with shoes.

A cable, chain or other flexible transmission means 28 passes about upper end pulleys 27 on the tower 22 and has one end fixed at 29 (Figures 1 and 3) to the truck 11 and its other end supporting a driving head of traditional type, indicated overall by 30, in which the drilling rods (not shown for simplicity) are clamped. As can be seen in Figures 1 and 2 and in the scheme of Figure 4, the driving head 30 is fixed to a frame 31 slidable vertically on the lattice 24 via rollers 32. To this frame there is fixed at 33 (Figure 3) one end of a secondary cable (or chain or other flexible means) 34, slidable about a pulley 35 pivoted in proximity to the lower end of the tower 22. The other end of the secondary cable 34 is fixed at 36 to a fixed point on the lattice 24 via a tensioning device 46.

As shown in Figure 4, the frame 31 supports the driving head 30 via an articulated quadrilateral linkage composed of a pair of rigid arms 40 and 41, both pivoted both to the frame 31 and to the head 30 and comprising a hydraulic piston 42 hinged at 43 to the frame 31 and at 44 to a lug 45 welded to the arm 41.

Again with reference to Figure 4 the articulated quadrilateral linkage is able to cause the driving head 30 to undergo a rotation-translation movement. In this respect, when the piston 42 extends, the arms 40 and 41 rotate anticlockwise to raise the head 30 and move it at the same time from the vertical line a, corresponding to the axis of the borehole, to the vertical line b (position shown dashed) coaxial with the service well for resting or taking up the drilling rods.

The operating cycle for the drilling rig 10 is as follows.

With reference to Figure 1, when a new drilling rod (not shown) is to be added to those already mounted, the telescopic tower 22 is initially at its lower end-of-travel position in the lattice 24.

When in this initial configuration the piston 23 is completely retracted and the tower 22 is contained within the lattice 24, from which the pulleys 27 project upperly.

By means of a hydraulic circuit (not shown for simplicity) the piston 42 of the articulated quadrilateral linkage is made to expand, to move the driving head 30 into the dashed configuration 30' to enable a new drilling rod taken from the service well to be fitted. By means of a main hydraulic circuit (not shown for simplicity) the piston 23 is made to expand, with consequent raising of the tower 22 within the lattice 24. During this movement the head 30 is raised upwards with twice the speed of the tower 22 plus the pulleys 27 and 35.

When the tower reaches its upper end-of-travel position (configuration shown dashed in Figure 1) the piston 42 is retracted, to return the head 30 coaxial with the borehole. Then having connected the new drilling rod to those already mounted, the driving head 30 is operated to drill a new portion. At the same time the hydraulic piston 23 is made to retract, with consequent lowering of the tower 22 and head 30.

During this drilling operation the cable 28 is slack, whereas the secondary cable 34 is put under tension to drag the head 30 downwards by the effect of the descent of the pulley 35 with the tower 22.

When the head 30 and hence the tower 22 are in their lower end-of-travel position, the head is halted to enable a further rod to be connected and a further drilling cycle to be performed.

To extract the drilling rods from the borehole, the exact reverse of the cycle described for drilling is performed.

As can be seen, the two vertical portions of the cable 28 lie symmetrically about the vertical axis of the tower 22, with the result that the pull exerts no flexural stress on the tower.

With regard to the cable 34, as this mainly pulls it can induce a bending moment on the tower, but of negligible extent.

For equal overall size when in the transporting position, a drilling rig comprising a telescopic tower according to the invention enables rods to be used having a length greater than, if not double, the length of the rods usable by a traditional D machine with a fixed tower.

Claims

1. A drilling machine of the type comprising a drilling tower (10) fixed in a reclinable manner on a transporting vehicle (11) and provided with motive power units (15) and a driving head (30) for driving the drill rods, the drilling tower (10) being of telescopic type slidable along a fixed guide structure or lattice (24) by the action of a hydraulic piston (23), the telescopic tower (22) being provided at its ends with a series of pulleys (25, 37) to allow the movement of flexible transmission means (28, 34) having one end connected to said driving head (30) and the other end connected to a point on the fixed structure (24), so as to form a closed ring about the tower (22);
characterised in that the driving head (30) is connected via an articulated quadrilateral linkage (40, 41, 42) to a rigid frame (31) slidable on the telescop-

ic tower (22), said quadrilateral linkage consisting of two rigid arms (40, 41) pivotally connected to the frame (12) and to the head (30) and a hydraulic piston means (42) pivotally connected to the frame (12) and to one of said rigid arms (40, 41), such that operation of said piston means (42) causes the head (30) to undergo a rotation-translation movement.

2. A drilling machine as claimed in claim 1, characterised in that said articulated quadrilateral linkage comprising two rigid arms (40, 41) both hinged to said frame (31) and to said driving head (30), and a hydraulic piston (42) pivoted to one (41) of said rigid arms (40, 41) and to the frame (31).

3. A drilling machine as claimed in claim 1, characterised in that the tower (22) is provided upperly with pulleys (27) about which one of said flexible means (28) slides.

4. A drilling machine as claimed in claim 1, characterised in that fixed to the bottom of the tower (22) is at least one pulley (35) about which a second flexible means (34) slides.

5. A drilling machine as claimed in claim 4, characterised in that said second flexible means (34) is connected to the lattice (24) via a tensioning device.

6. A drilling machine as claimed in claims 1 to 5, characterised in that the vertical portions of each flexible means (28, 34) are arranged substantially symmetrical about the vertical axis of the tower (22).

7. A drilling machine as claimed in claim 1, characterised in that in use when the piston (42) is in its retracted state the driving head (30) is coaxial with the borehole, and when said piston is in its expanded state, the head (30) is in a position (30') displaced from the vertical axis (a) of the borehole.

Patentansprüche

1. Bohrmaschine, die einen Bohrturm (10) umfaßt, der kippbar auf einem Transportfahrzeug (11) befestigt ist und mit Triebwerken (15) und einem Antriebskopf (30) zum Antreiben der Bohrstangen ausgestattet ist, wobei der Bohrturm (10) teleskopartig ausziehbar und durch die Wirkung eines hydraulischen Kolbens (23) entlang einer festen Führungsstruktur oder eines Führungsgitters (24) gleitbar ist, wobei der teleskopartig ausziehbare Turm (22) an seinen Enden mit einer Reihe von Rollen (27, 35) ausgestattet ist, um die Bewegung von flexiblen Übertragungsmitteln (28, 34) zu ermöglichen, deren eines Ende mit dem Antriebskopf (30) und deren anderes Ende mit einem Punkt auf der festen Struktur (24) verbunden ist, um einen geschlossenen Ring um den Turm (22) zu bilden;
dadurch gekennzeichnet,
daß der Antriebskopf (30) über ein gelenkiges vierseitiges Gestänge (40, 41, 42) mit einem starren Rahmen (31) verbunden ist, der gleitbar auf dem teleskopartig ausziehbaren Turm (22) montiert ist, wobei das vierseitige Gestänge aus zwei starren Armen (40, 41), die gelenkig mit dem Rahmen (31) und dem Kopf (30) verbunden sind, und einem hydraulischen Kolbenmittel (42) besteht, das gelenkig mit dem Rahmen (31) und mit einem der starren Arme (40, 41) verbunden ist, so daß eine Betätigung des Kolbenmittels (42) bewirkt, daß der Kopf (30) eine Dreh-Verschiebebewegung vollzieht.

2. Bohrmaschine nach Anspruch 1,
dadurch gekennzeichnet,
daß das gelenkige vierseitige Gestänge zwei starre Arme (40, 41), die beide mit dem Rahmen (31) und dem Antriebskopf (30) gelenkig verbunden sind, und einen hydraulischen Kolben (42) umfaßt, der gelenkig mit dem einen (41) der starren Arme (40, 41) und dem Rahmen (31) verbunden ist.

3. Bohrmaschine nach Anspruch 1,
dadurch gekennzeichnet,
daß der Turm (22) im oberen Bereich mit Rollen (27) ausgestattet ist, um welche eines der flexiblen Mittel (28) gleitet.

4. Bohrmaschine nach Anspruch 1,
dadurch gekennzeichnet,
daß am Boden des Turms (22) wenigstens eine Rolle (35) befestigt ist, um welche ein zweites flexibles Mittel (34) gleitet.

5. Bohrmaschine nach Anspruch 4,
dadurch gekennzeichnet,
daß das zweite flexbile Mittel (34) über eine Spannungsvorrichtung mit dem Gitter (24) verbunden ist.

6. Bohrmaschine nach den Ansprüchen 1 bis 5,
dadurch gekennzeichnet,
daß die vertikalen Bereiche jedes flexiblen Mittels (28, 34) im wesentlichen symmetrisch zur vertikalen Achse des Turms (22) angeordnet sind.

7. Bohrmaschine nach Anspruch 1,
dadurch gekennzeichnet,
daß bei Gebrauch, wenn der Kolben (42) in seinem zurückgezogenen Zustand ist, der Antriebskopf (30) koaxial mit dem Bohrloch ist, und wenn der Kolben in seinem ausgefahrenen Zustand ist, der Kopf (30) in einer Position (30') steht, die von der vertikalen Achse (a) des Bohrlochs versetzt ist.

Revendications

1. Machine à forer du type comprenant une tour de forage (10) fixée d'une manière inclinable sur un véhicule transporteur (11) et équipée d'unités de puissance motrice (15) et d'une tête de commande (30) pour entraîner les tiges de forage, la tour de forage (10) étant de type télescopique coulissant le long d'une structure de guidage fixe ou treillis (24) sous l'effet d'un piston hydraulique (23), la tour télescopique (22) étant munie sur ses extrémités d'une série de poulies (25, 37) permettant le mouvement de moyens de transmission souples (28, 34) avec une extrémité raccordée à la tête de commande (30) et l'autre extrémité raccordée à un point sur la structure fixe (24) de façon à former un anneau fermé sur la tour (22) ;

   caractérisée en ce que la tête d'entraînement ou de commande (30) est raccordée par une articulation quadrilatérale (40, 41, 42) à un châssis rigide (31) pouvant coulisser sur la tour télescopique (22), cette articulation quadrilatérale consistant en deux bras rigides (40, 41) raccordés de façon pivotante sur le châssis (12) et sur la tête (30) et un piston hydraulique (42) raccordé de façon pivotante sur le châssis (12) et sur l'un des bras rigides (40, 41) de telle sorte que le fonctionnement du piston (42) fait subir à la tête (30) un mouvement de rotation-translation.

2. Machine à forer selon la revendication 1, caractérisée en ce que l'articulation quadrilatérale comprenant deux bras rigides (40, 41) tous deux articulés sur le châssis (31) et sur la tête de commande (30) et un piston hydraulique (42) mis en pivotement sur l'un (41) des bras rigides (40, 41) et sur le châssis (31).

3. Machine à forer selon la revendication 1, caractérisée en ce que la tour (22) est équipée dans sa partie supérieure de poulies (27) autour desquelles l'un des moyens souples (28) coulisse.

4. Machine à forer selon la revendication 1, caractérisée en ce qu'au moins une poulie (35) est fixée sur le fond de la tour (22), poulie autour de laquelle coulisse un second moyen souple (34).

5. Machine à forer selon la revendication 4, caractérisée en ce que les seconds moyens souples (34) sont raccordés au treillis (24) par un dispositif tendeur.

6. Machine à forer selon les revendications 1 à 5, caractérisée en ce que les portions verticales de chaque moyen souple (28, 34) sont disposées sensiblement de façon symétrique autour de l'axe vertical de la tour (22).

7. Machine à forer selon la revendication 1, caractérisée en ce que dans l'utilisation, lorsque le piston (42) est dans sa position rentrée, la tête de commande (30) est coaxiale avec le trou de forage et lorsque le piston est dans sa position sortie, la tête (30) se trouve dans une position (30') déplacée par rapport à l'axe vertical (a) du trou de forage.

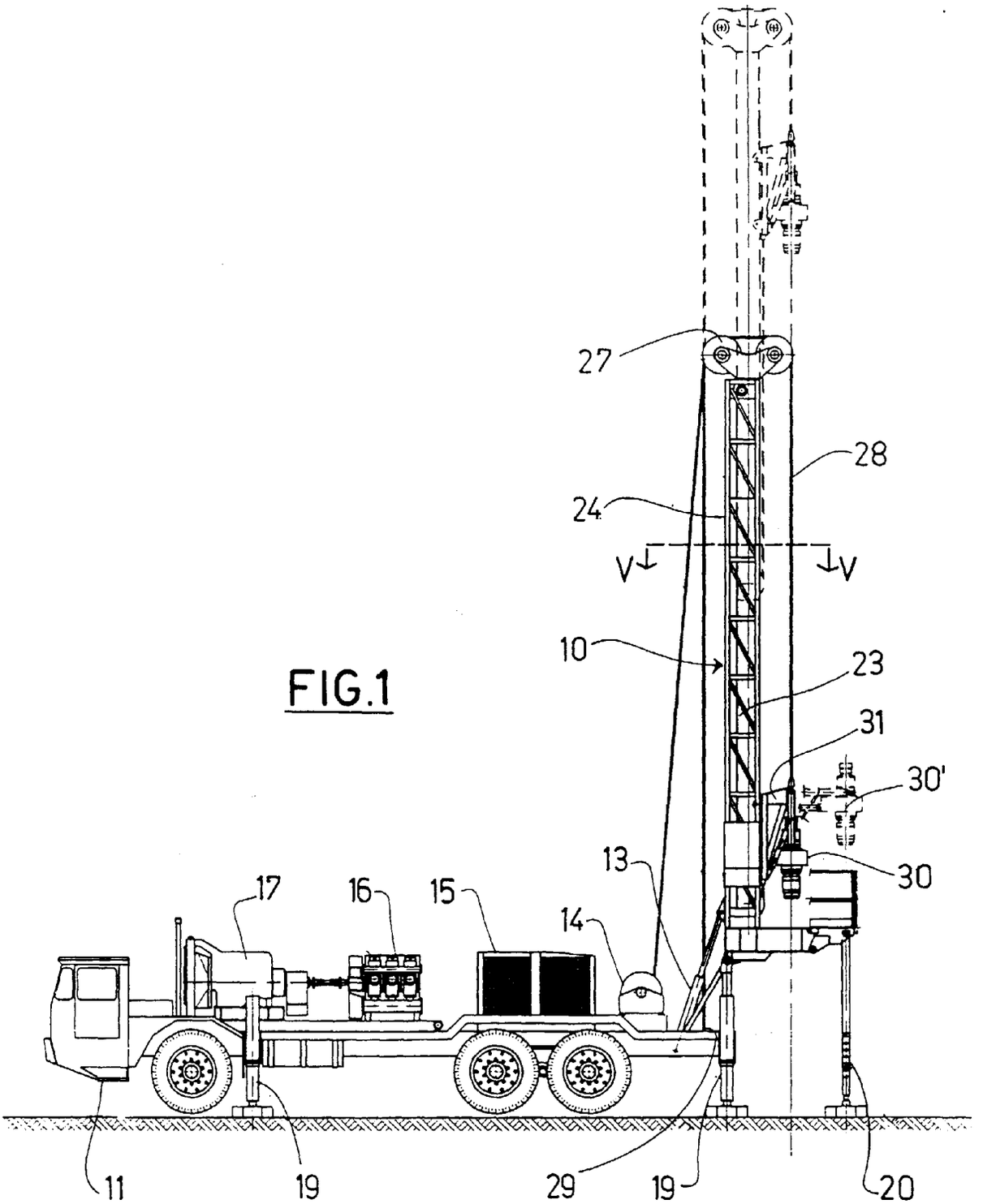

FIG.1

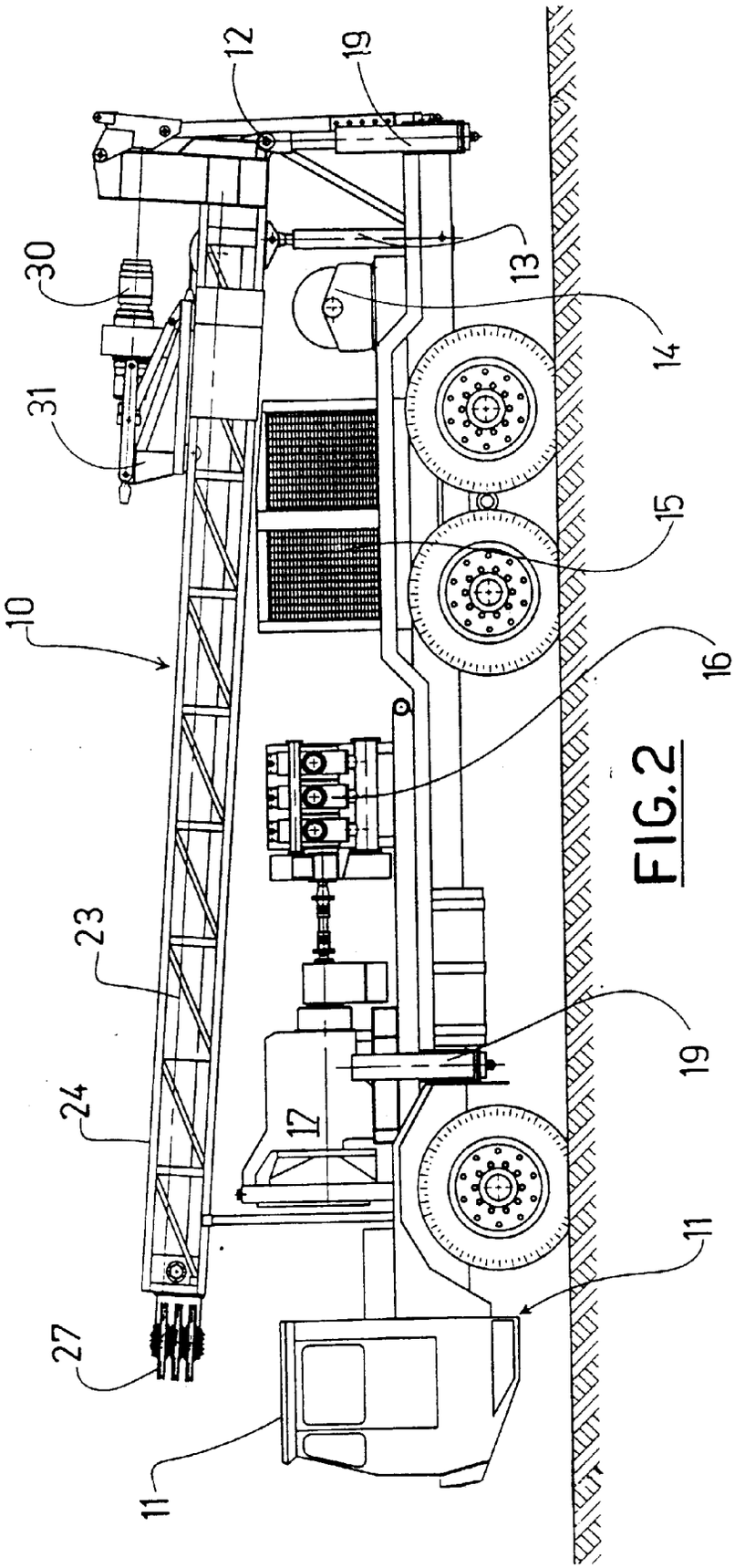

FIG.2

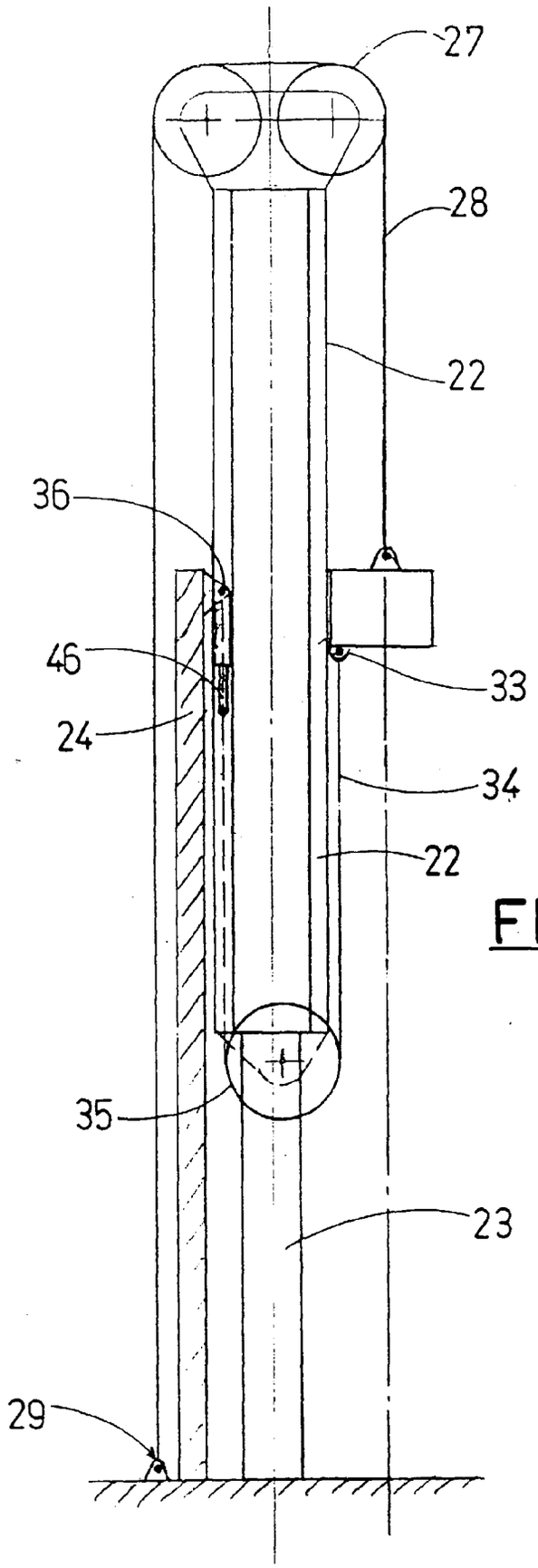

FIG.3

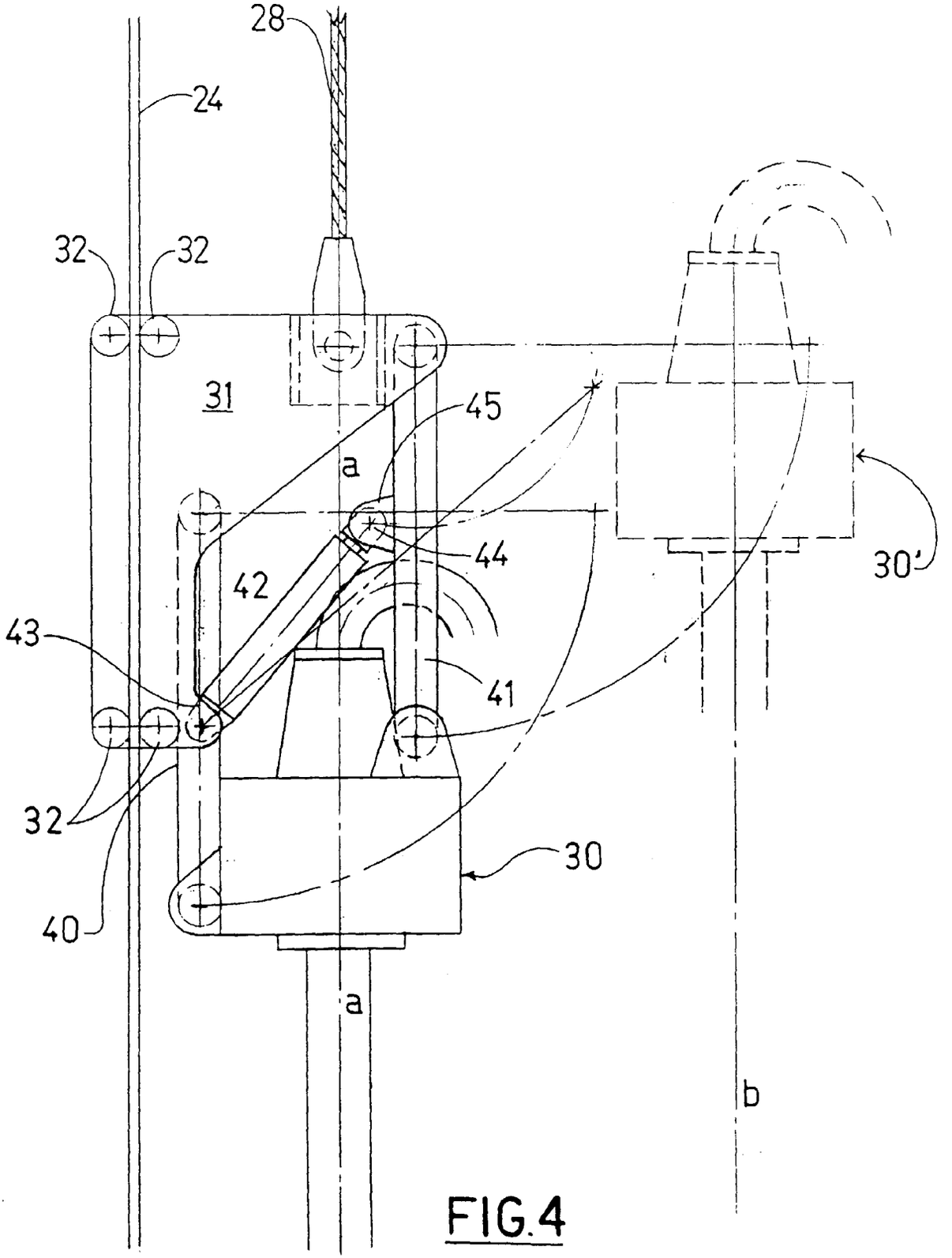

FIG.4

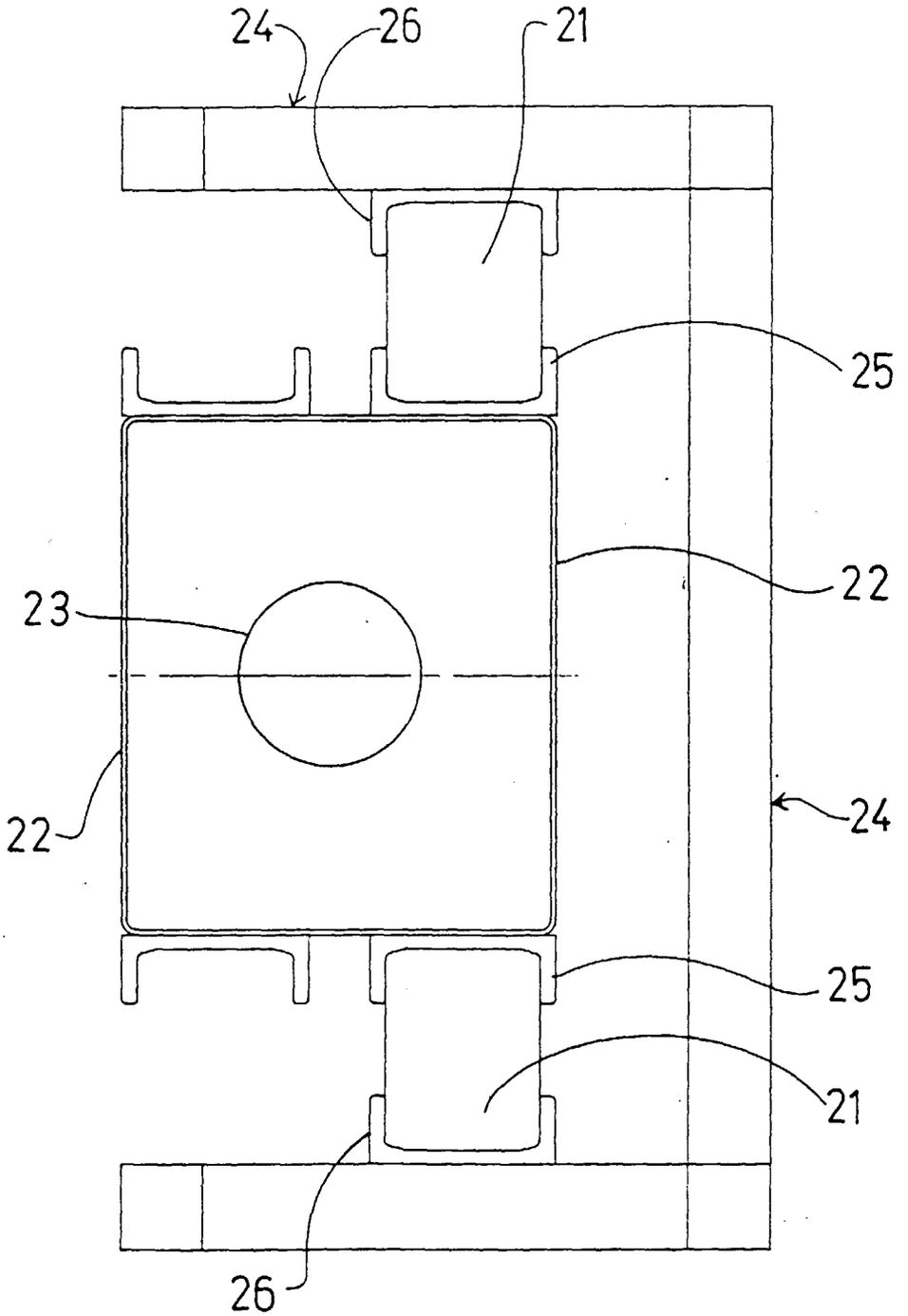

FIG.5