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Kolderup et al.

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[54] **MOBILE DRILL RIG**

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[52] **U.S. Cl.** **248/16**, 173/28, 173/43

[51] **Int. Cl.** **E21c 11/02**

[58] **Field of Search** 212/66, 67; 248/2, 16; 173/22, 23, 27, 28, 38, 43

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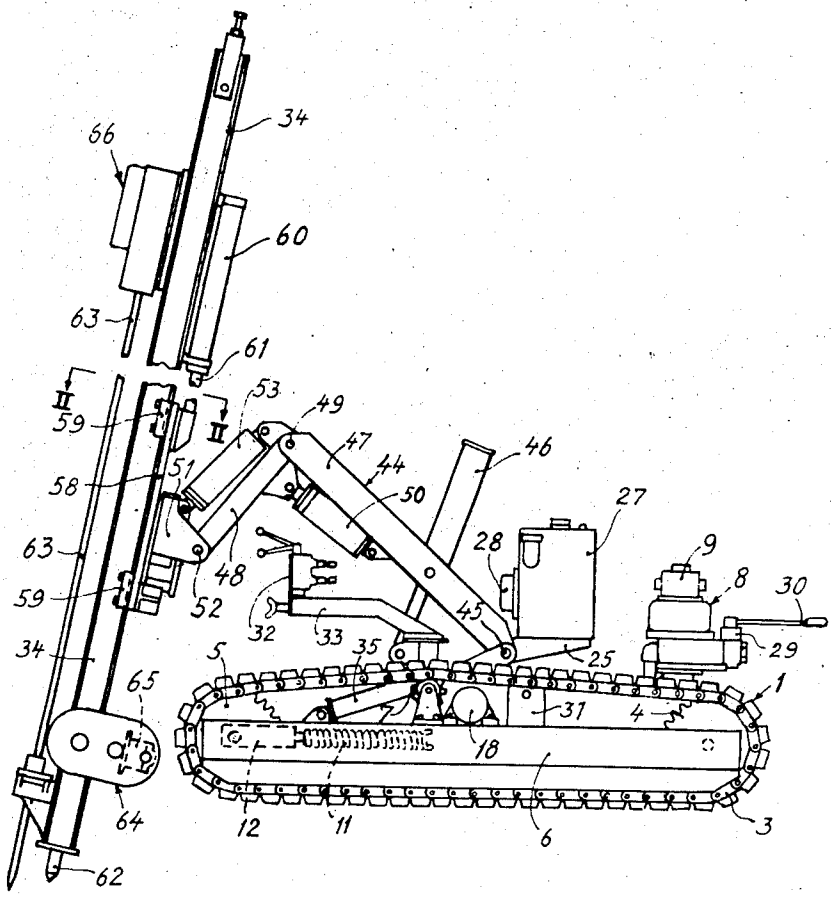
[57] **ABSTRACT**

For a mobile drill rig of the caterpillar type it is proposed to mount the turntable on which the drill boom is pivoted, on a substantially vertical shaft placed substantially centrally within the vehicle and having a direct rack and pinion drive from two opposed hydraulic cylinders forming part of the connection between the chassis of the vehicle and the respective track frame structures. One of the track frame structures is rigidly connected to the chassis, and the other is capable of pivotal motion about the axis of the cylinders. The drill boom has a pivotal joint therein, permitting it to form an adjustable downward angle.

10 Claims, 8 Drawing Figures



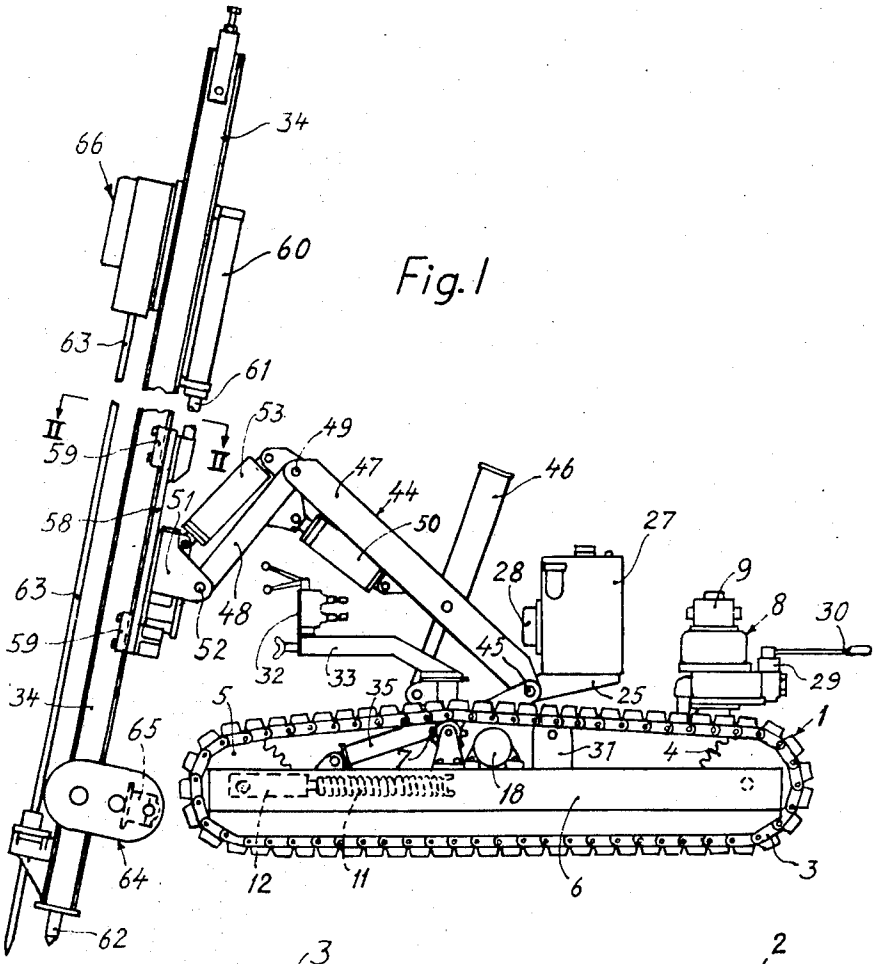

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Fig. 1

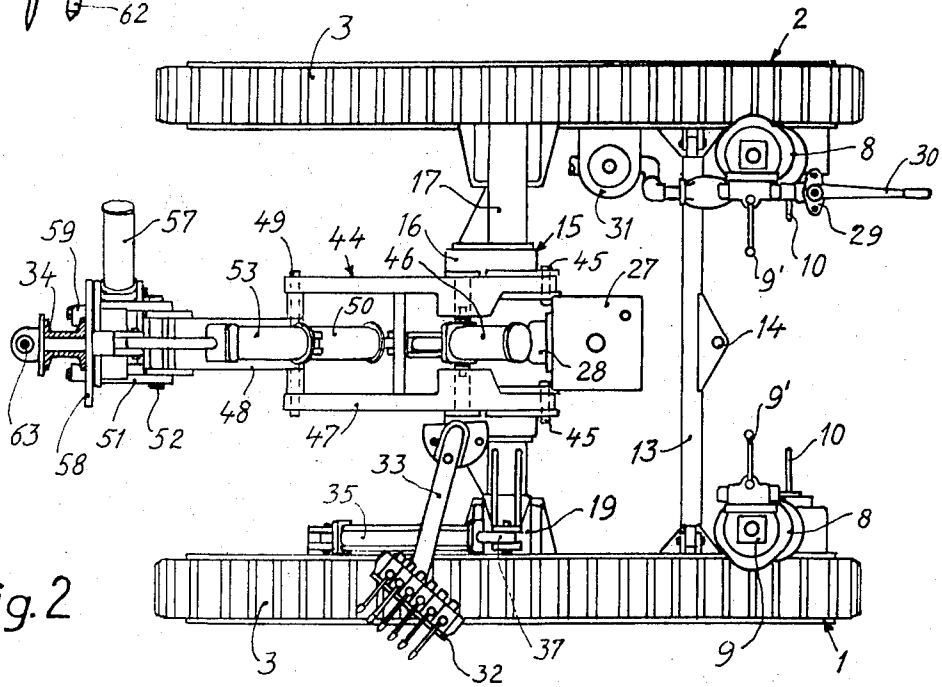
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Fig. 2

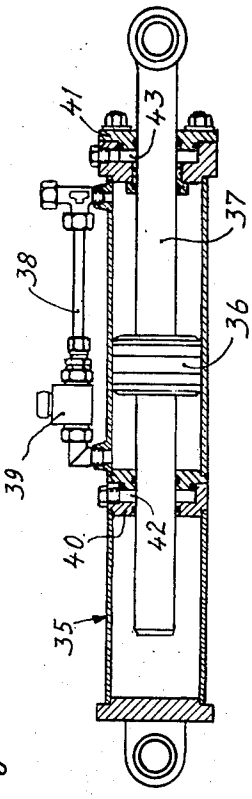
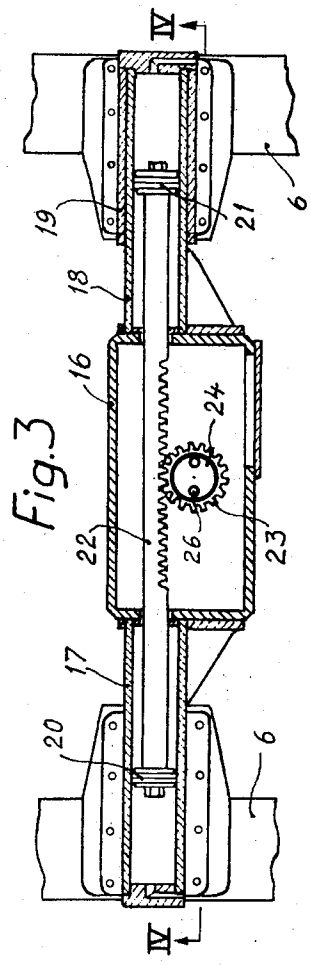


Fig. 5



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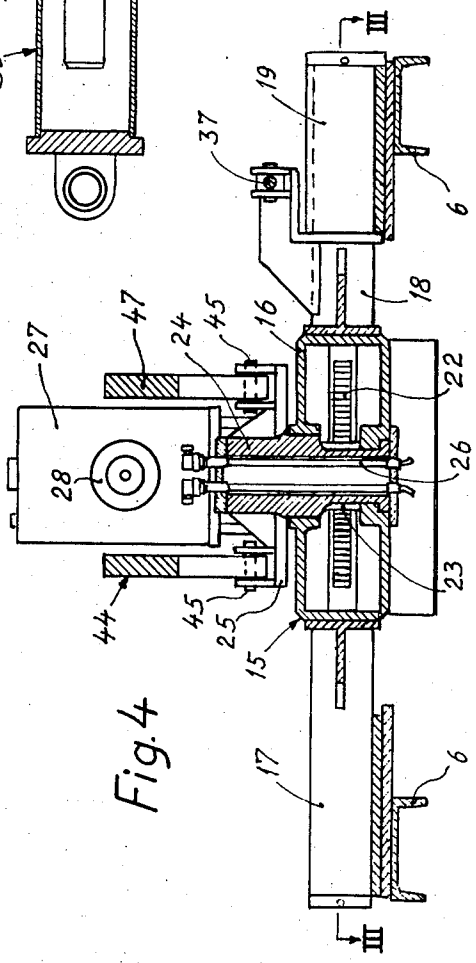


Fig. 4

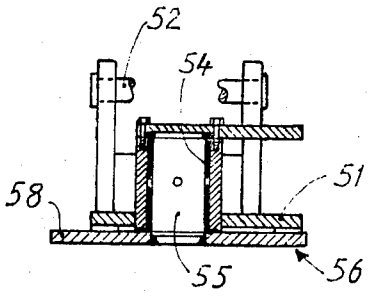


Fig. 8

Fig. 6

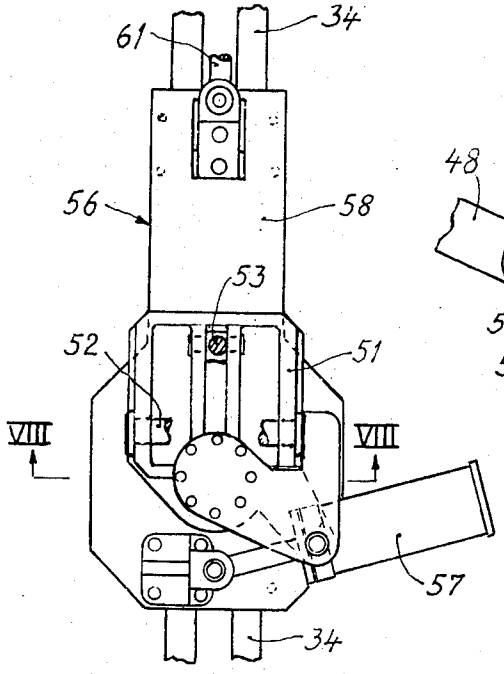
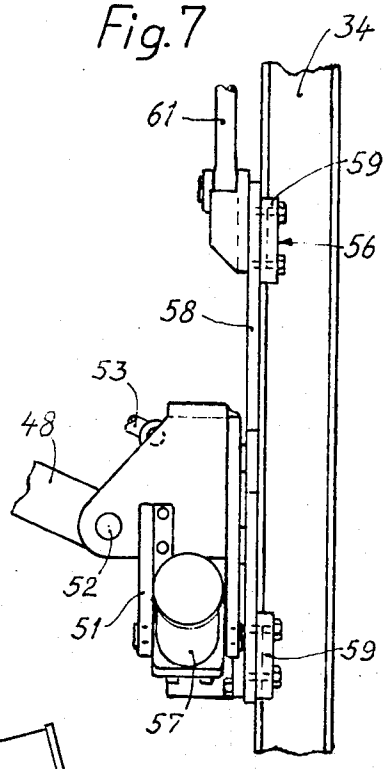


Fig. 7



MOBILE DRILL RIG

BACKGROUND OF THE INVENTION

The invention relates to drill rigs of the caterpillar type with a boom which in one end is mounted for pivotal motion about a substantially horizontal axis, and with a feed mast mounted for longitudinal adjustment in a guide pivoted on the free end of the boom, and with hydraulic operation for effecting the positioning movements. In known designs of such drill rigs the boom can either be rotated only in a given vertical plane in relation to the chassis of the vehicle, or it is pivoted on a turntable which itself is mounted for rotation about a substantially vertical axis on the chassis approximately midway between the track frames. In the latter case a certain rotation of the boom to either side of the longitudinal vertical plane of the vehicle is possible by means of hydraulic cylinders operating between the chassis and the boom, but only within a rather limited angular range. These limitations with respect to the possibilities of positioning the boom are disadvantageous because they necessitate frequent repositioning of the drill rig when shifting to a new hole and because terrain and other conditions of operating space frequently hamper the placing of the drill rig in positions suitable for the various drilling operations.

SUMMARY OF THE INVENTION

The invention seeks to overcome the above drawback and contemplates that the turntable be carried by a shaft centrally located in the vehicle with direct rack and pinion operation from a common connecting piston rod between two hydraulic cylinders fixed to the chassis and having sufficient stroke length for rotating the platform 360°.

Thereby it becomes possible to position the vertical plane of rotation of the boom in relation to the vehicle in any direction while the vehicle remains stationary, and thereby to carry out more drilling operations without moving the drill rig and also to obtain easier access and safer positioning of the feed mast for desired drilling operations even under difficult space conditions.

The said rack and pinion operation can be obtained with an adequate tooth module for properly taking up the forces involved — even when the feed mast is working laterally in relation to the vertical longitudinal plane of rotation of the boom — and at the same time with a sufficient stroke for 360° rotation by means of a favorable space-saving location of the cylinders in the transverse direction of the vehicle, while at the same time keeping the overall width of the vehicle sufficiently small to permit transportation of the drill rig on a standard truck body.

Contrary to known designs where the two track structures, are capable of pivoting in relation to each other about a transverse axis located in the rear part of the vehicle for adjusting themselves to the terrain conditions, according to the invention the boom can be rotated 360° in the horizontal plane and this axis can be located approximately midway of the length of the track frames in order to operate under conditions as symmetrical conditions as possible and also to make the chassis as compact as possible, with a resulting possibility of positioning the mast at a short distance from the turntable axis in front of or behind the chassis and

to obtain the most favorable center of gravity positions.

An especially favorable feature of the invention in this respect is that the axis for relative pivoting of the track structures is concentric to the said cylinders and these form part of the connection between the chassis and the track frames. By this location of the axis of relative oscillation of the track frames, the maximum height difference between them, i.e. the height difference at maximum oscillation angle - is reduced, which makes it possible to simplify the construction by having one of the track frames rigidly fixed to the adjoining cylinder and having the other track frame mounted for pivotal motion about the other cylindrical with the possibility of fixation by means of a hydraulic damping cylinder device with an adjustably throttled by-pass.

Another important feature of the invention is that the boom is provided with an intermediate pivotal joint permitting it to adopt a downward angle which can be adjusted by means of a hydraulic cylinder. Thereby, it is possible to obtain a relatively low positioning of the boom head, in other words a relatively small slope of the connection line between the mounting point of the boom and the mounting point of the boom head, even in positions with relatively small horizontal clearance and hence in positions of the feed mast near to the chassis of the vehicle, so that unfavorable directions of the forces applied to the mast by the boom can be avoided.

Further, because of the downward angle of the boom, it is also possible to move the boom head downwards to low levels adjacent the vehicle, which is particularly favorable if the feed mast guide is pivoted for lateral rotation by at least 90° with a view to permitting horizontal drilling, as it will then be possible to drill horizontally and parallel to the vehicle beside the same at low levels.

As most of the hydraulic cylinders required for the various positioning movements are incorporated in the rotating system supported by the turntable, it is most suitable to mount the hydraulic oil tank on the latter. But since some cylinders, in particular the cylinders for moving the rack, do not take part in the rotation, it is convenient to make the pinion shaft carrying the turntable, hollow and permit it to extend straight through to the bottom side of the chassis so as to permit conduits to be passed therethrough to these cylinders in order that the control devices for the operation of the positioning cylinders and of the working system of the drill rod shall not be unsuitably located or be in the way, irrespective of the position of the turntable, it is preferable to mount a control valve panel on an arm which is carried by the turntable and which can be rotated in relation to the same about a substantilly vertical axis.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Other features of the invention will appear from the following detailed description of a preferred embodiment which is illustrated in the accompanying drawings, in which

FIG. 1 shows a drill rig viewed from the left side,

FIG. 2 is a top view of the drill rig chassis with the mast in the vertical position and in section along the line II—II in FIG. 1,

FIG. 3 is a top view of the chassis in section along the line III—III in FIG. 4,

FIG. 4 is a front view of the chassis and turntable in section along the line IV—IV in FIG. 3,

FIG. 5 is a view in longitudinal section of the hydraulic damping cylinder for one of the track structures,

FIG. 6 is a rear view of the boom head and the mast guide,

FIG. 7 is a right-hand view of the same, and

FIG. 8 shows the same as viewed from below and in section along the line VIII—VIII in FIG. 6.

DETAILED DESCRIPTION

In the embodiment shown the track structures 1 and 2 of the drill rig are as usual fitted with caterpillar tracks 3 consisting of chains carrying track shoes and running over a driving wheel 4 at the rear end, a rotatable wheel 5 at the front end and guide rollers, all mounted on a fixed frame 6 in the respective track structure. The guide rollers along the bottom side are not visible in the drawings, but in FIG. 1 a single roller 7 for the upper run of the track can be seen. The driving wheels 4 are operated from separate drive units 8, which are mounted on the respective track frames 6, and each of which may consist of a compressed air motor 9 with a valve lever and reduction gear and capable of being engaged and disengaged by means of a lever 10. Further, each track structure may be fitted with a track tensioning spring 11 and the tensioning may be adjustable by means of a hydraulic cylinder 12. Near the rear end the track frames 6 are interconnected by a link rod 13 which has a certain slack permitting relative vertical movement and which is adapted, if desired, for connection, at point 14, of a towing truck or of a portable compressor which can be pulled by the drill rig and feed its compressed air system.

The actual vehicle chassis 15 of the drill rig consists mainly of a reduction gear box 16 which is centrally located in the vehicle and which is extended to both sides by a pair of aligned hydraulic cylinders 17 and 18 extending through their respective track structures 1 and 2 approximately to the outer edge thereof. The cylinder 17 is rigidly attached to the frame 6 in the right-hand track structure 2, whereas the cylinder 18 is supported for pivotal motion, but not for longitudinal displacement in a bearing 19, attached to the left-hand side track frame 6. In the cylinders 17, 18 a pair of pistons 20 and 21, respectively, act on a common piston rod 22, the central part of which is formed as a rack, which engages a pinion 23. The latter is integral with a hollow shaft 24 which extends vertically through and is journalled in the box 16 and carries a turntable 25 of the drill rig. The cylinders 17 and 18 with pistons and rack and pinion transmission are arranged for effecting rotation of the turntable 25 through an angle of 180° to either side from the central position shown. Hydraulic liquid is supplied to the outer ends of the cylinders 17 and 18 and to the remaining hydraulic cylinders of the drill rig from a source of hydraulic pressure mounted on the turntable 25 and consisting of an oil tank 27 and a pump unit 28 driven by compressed air.

Most of the conduit systems for hydraulic liquid and for compressed air are not shown on the drawings as this would make the drawings difficult to understand and unnecessarily complicated and, besides, these systems are conventional, except that conduits 26 for feeding the cylinders 17 and 18 are passed through the hollow shaft 24.

As regards the compressed air system it is indicated in FIG. 2 that on the track frame 6 rigidly fixed to the chassis, there are mounted a supply valve 29 with a shut-off lever 30 as well as a lubricator 31, from which the compressed air can entrain oil for lubricating various devices driven by compressed air and also for lubricating and cleaning the track chains and the feed chain by means of the exhaust air. For the control of the respective working and positioning operations, manually operated valves are provided, which are combined into a control panel 32 carried by an arm 33, which is mounted on the turntable 25 and can be positioned at different angles in a horizontal plane.

Thanks to the rotatable mounting of the cylinder 18 in the left-hand track structure 1, this structure will adjust itself in relation to the remaining part of the drill rig by following the terrain. In operation the weight of the vehicle is to be transmitted to the feed mast 34, and a rigid connection between the frame 6 of the track structure 1 and the chassis 15 has to be established. For this purpose there is provided a hydraulic bracing and damping piston-cylinder unit 35 as shown in detail in FIG. 5. The piston 36 works in a chamber through which the piston rod 37 extends with a slideable fit at the ends, and a by-pass conduct 38 extends from one end of the chamber to the other and is fitted with an adjustable throttling valve 39. By adjusting the valve 39 it is thereby possible to achieve both an adjustable damping of the oscillating movement of the track frame 1 in the terrain and also a locking of the piston when a rigid connection is required. A problem in this connection is, however, that it is difficult to obtain a perfect sealing of the end walls of the cylinder chamber against leakage, which may cause sagging of the track structure in operation. Sealing gaskets as such have proved inadequate, and therefore, in addition to gaskets, closed oil chambers 42, 43 are provided in the end walls 40, 41, which has proved to afford an adequate seal.

Numeral 44 designates the drill rig boom, which is rotatably mounted on horizontal pivots 45 on the turntable 25 and can be adjusted in relation to the latter by means of a hydraulic cylinder 46. The boom 44 is composed of two sections 47, 48 linked together by a pivotal joint the axis 49 of which is parallel to that of the pivots 45, and interconnected by a hydraulic cylinder 50 so that they can be adjusted for adapting different downwardly facing angles in relation to each other. The boom is symmetrical with respect to a vertical plane passing through the pivotal axis of the turntable and the boom carries at its outer end a boom head 51 which can be rotated in the swinging plane of the boom on a pivot 52 on the boom section 48 by means of a hydraulic cylinder 53 connected to the boom section 47. The boom head 51 is fitted with a rotational bearing for a supporting pin 55 with axis in the vertical swinging plane of the boom. The guide 56 can be rotated about this axis by a hydraulic cylinder 57. On the mast guide 56 and the feed mast 34 is supported for displacement in its longitudinal direction. The mast guide 34 mainly consists of an elongated plate 58 with fittings 59 bolted thereto, which engage flanges of the mast in the manner of a dovetail guide. The position of the mast in the guide can be adjusted by means of the elongated hydraulic cylinder 60 which is mounted on the mast near

the top and is connected to the guide **56** by its piston rod **61** and which presses the lower end of the mast with its fixation point **62** against the ground so as to transmit the weight of the drill rig during operation.

The construction of the remainder of the feed mast with its operational devices for operating the drill rod has only been indicated diagrammatically, as it does not as such concern the invention and may be conventional. The feed mast **34** is shown as consisting of two channel sections with the webs facing each other, and the operational devices for the drill rod include a drive unit **64** which is mounted near the lower end of the mast and may consist of a compressed air motor **65** with reduction gear for driving an endless feed chain which extends along the mast and is fixed to a working unit **66** with percussion and rotation devices for the drill rod **63.**

It will be seen that with the embodiment shown, there is obtained an extensive flexibility as to the positioning of the mast with respect to position and working direction, in combination with a low positioning of the boom head **51** and a large angle between the drilling direction and the connection line between the pivotal points **45** and **52** at the boom ends, so that the weight of the drill rig can be efficiently utilized during drilling. It will further be seen that due to the articulation of the boom at the joint **49** it is also possible to work very low at the side of the vehicle, and that it is also possible, when required, to place the mast close to the vehicle, while at the same time the drill rig as a whole has a low profile and further the boom and the mast can be moved into flat position in low height on top of the vehicle during transport.

Even though, when the mast is placed in the mast guide **56** in the manner shown, it can only be rotated clockwise in the lateral direction in relation to the central position shown in FIG. 7 — which for horizontal drilling next to the vehicle would involve drilling forwards on the right-hand side and backwards on the left-hand side — a change of the drilling direction can easily be arranged be repositioning of the link connections of the cylinder **57.**

What we claim is:

1. A mobile drill rig comprising two spaced track structures each with a caterpillar track, a chassis, means supporting said chassis from said track structures, a boom having opposite ends, a turntable supported on said chassis for rotation about a substantially vertical axis, means connecting one end of the boom to the turntable for pivotal movement about a horizontal axis, a guide means pivotably connected to the other end of the boom, a drill mast supported in said guide means for longitudinal adjustment thereon, said means supporting the chassis from the track structures comprising two hydraulic cylinders coupled to respective track structures, and aligned in the transverse direction relative to said track structures to serve to provide a mechanical load supporting connection between the chassis and the track structures, said track structures each including separate drive means, said cylinders being supported by the track structures such that the track structures can be pivotably moved relative to one another about a transverse axis concentric with said cylinders and located approximately midway of the length of the track structures, a common piston rod for said cylinders, and means coupled to said common piston rod and said turntable for rotating the latter by displacement of the common piston rod and including a rack and pinion drive, said rack being integral with said piston rod, said turntable having a rotatable shaft to which the pinion is secured; and rotational bearing means between the guide means and said boom to permit said guide means to be rotated at least 90° laterally of the swinging plane of the boom about an axis in said plane.

2. A drill rig as claimed in claim **1** wherein the shaft of the turntable is hollow, said rig further comprising hydraulic operating means for said cylinders including conduits passed through said shaft to the said cylinders.

3. A drill rig as claimed in claim **1** wherein said boom includes a pivotal joint permitting the boom to adopt a downwardly facing angle, and cylinder means coupled to the boom for adjusting said angle.

4. A drill rig as claimed in claim **1** comprising a control valve panel for the operation of the hydraulic cylinders, and an arm mounted on the turntable and adapted to be respositioned in relation thereto about a substantially vertical axis, said panel being mounted on said arm.

5. A drill rig as claimed in claim **1** wherein one track structure includes a frame rigidly attached to the adjoining cylinder and the other track structure includes a frame mounted for pivotal movement around the other cylinder.

6. A drill rig as claimed in claim **5** comprising a hydraulic damping piston-cylinder unit having an adjustably throttled by-pass for controlling the freedom of pivotal movement of the frame around said other cylinder.

7. A drill rig as claimed in claim **6** wherein said damping piston-cylinder unit comprises end covers, annular sealing gaskets in said end covers and fluid chambers located between said gaskets.

8. A drill rig as claimed in claim **1** wherein said rotational bearing means comprises a boom head supported for pivotal movement in the swinging plane of the boom, and a rotational bearing between the guide means and said boom head.

9. A drill rig as claimed in claim **1** wherein said track structures have outer faces and said cylinders extend in said track structures to said outer faces.

10. A drill rig as claimed in claim **22** wherein said common piston rod has a stroke sufficient to turn the turntable through an angle of 360°.

* * * * *