

[54] **SUPPORT MEANS FOR MAST MOUNTED DRILL**

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[51] Int. Cl. **E21c 5/06**

[58] Field of Search **173/20, 147, 160**

[56] **References Cited**

UNITED STATES PATENTS

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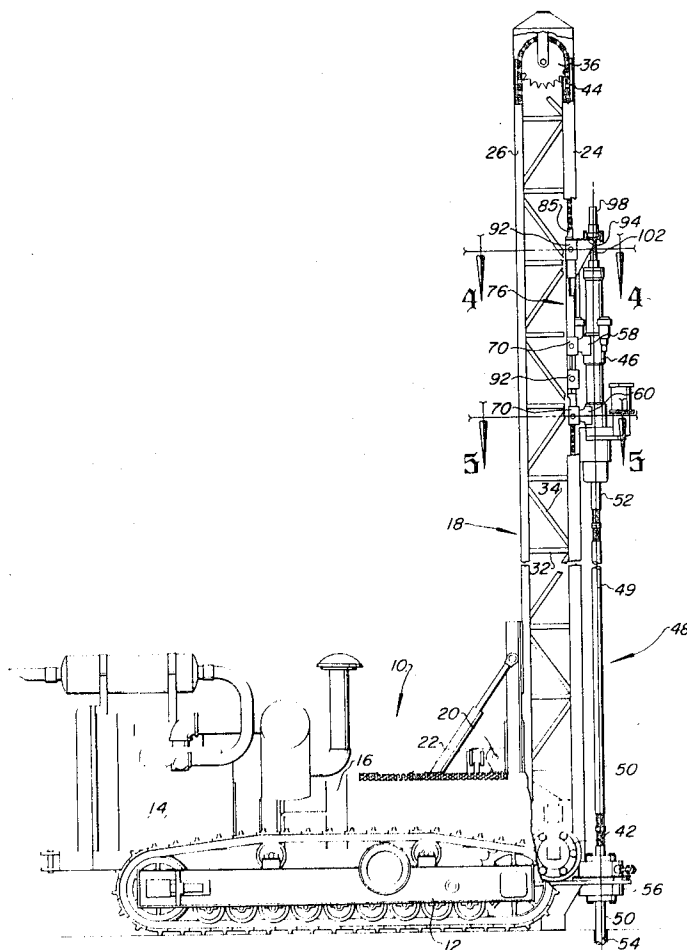
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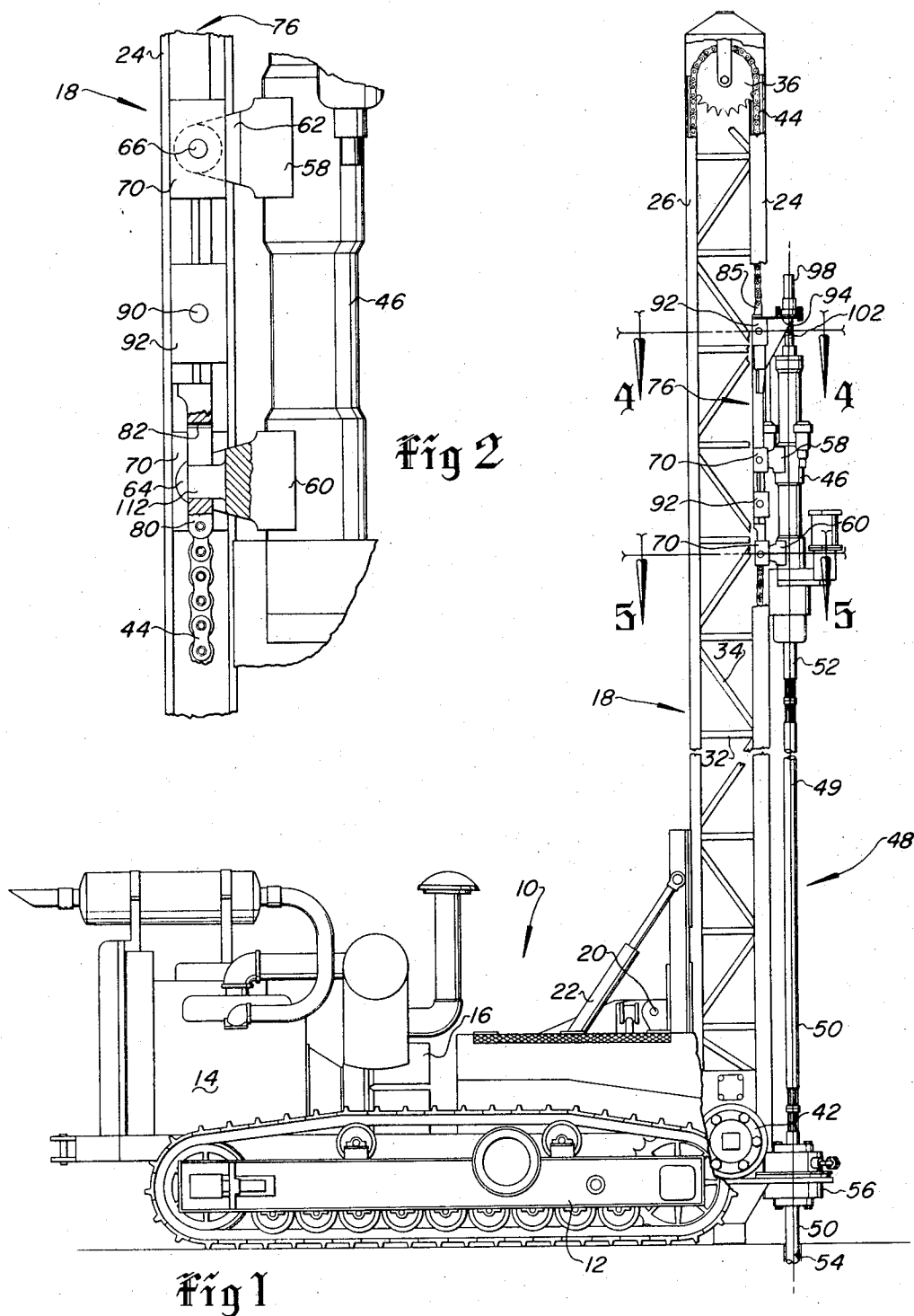
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[57] **ABSTRACT**

A mast mounted percussion rock drill having a force transmitting frame which provides for a feed force to be exerted on the drill and drill string in a direction which is coaxial with the longitudinal axis of the drill string. The force transmitting frame is adapted to be slidably retained in a mast structure having spaced inwardly facing channel members. The force transmitting frame is attached to a single feed chain centrally located on the drill mast and includes a hydraulic force sensor for directly sensing the feed force on the drill.

8 Claims, 6 Drawing Figures





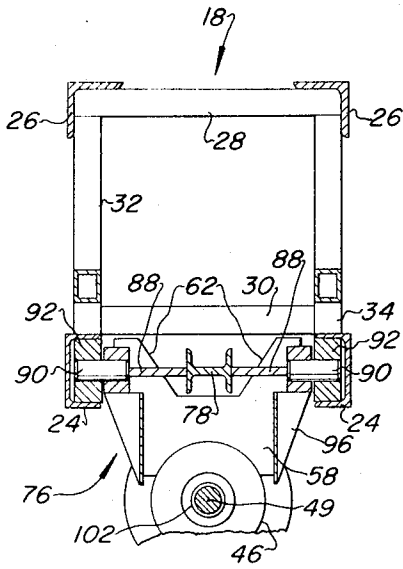


Fig 4

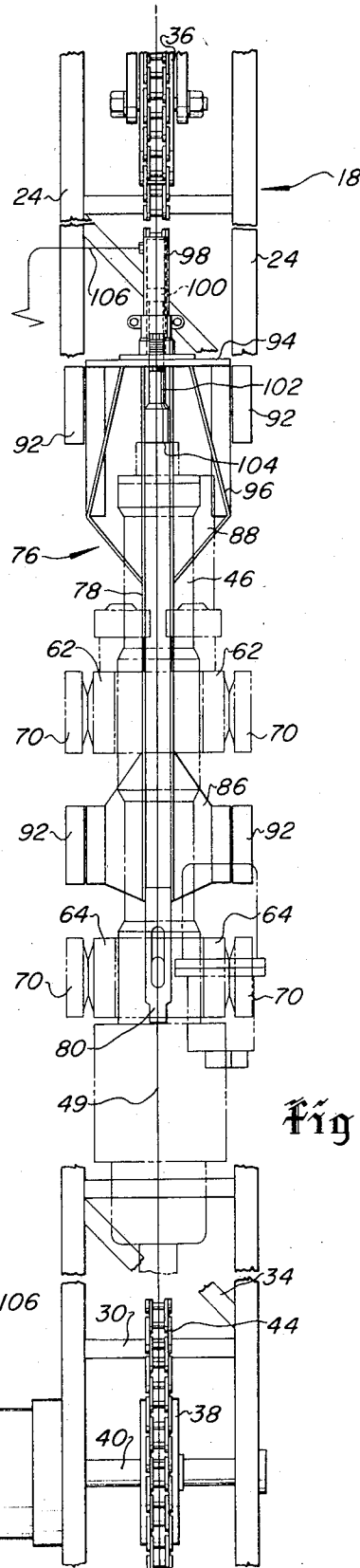
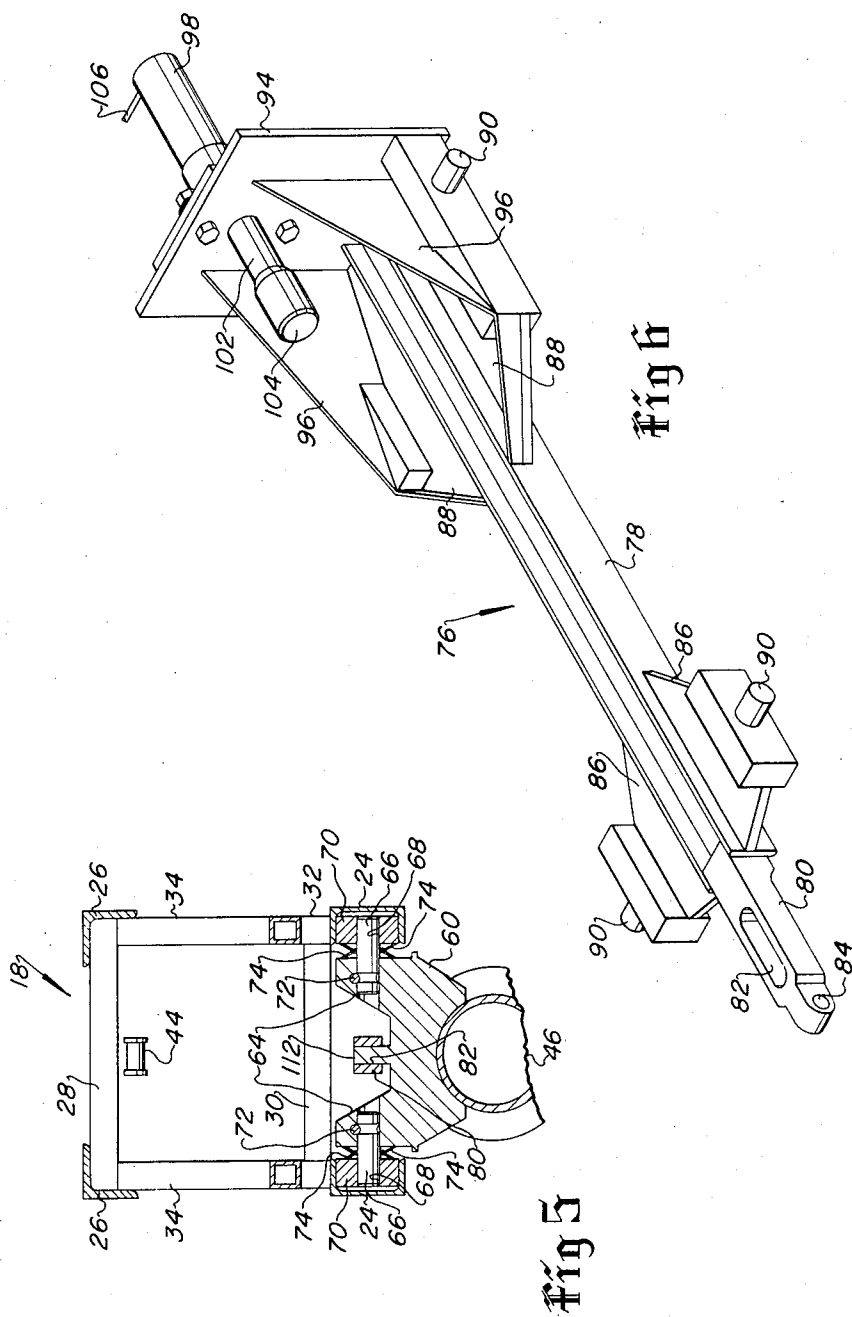


Fig 3



SUPPORT MEANS FOR MAST MOUNTED DRILL

BACKGROUND OF THE INVENTION

In the art of rock drilling apparatus it is well known to movably mount the drill motor proper on an elongated feed support or mast for feeding the extension drill string into the drill hole. The drill motor is normally mounted on a sliding bracket or frame which in turn is connected to feed means such as an arrangement of flexible chains or cables suitably supported on the mast and driven by a feed motor.

In particular, with regard to percussion rock drills slidably mounted on a mast or similar feed support, it has been a long-standing problem to suitably mount the drill motor so that the feed force is applied coaxially with the longitudinal axis of the drill string. Application of the feed force coaxial with the axis of the drill string has been found to be desirable to reduce the tendency for bending or buckling of the slender column formed by the end-to-end coupled extension drill rod sections which make up the drill string. Prior art drill mountings in which the feed force is applied to the drill motor at some point spaced from the centerline of the drill string have largely suffered from a tendency for the drill motor to overturn or cock and thereby cause the aforementioned bending load on the drill string. Certain prior art feed arrangements for mast mounted rock drills have attempted to solve the aforementioned problem by utilizing pairs of feed chains mounted on each side of the drill motor proper and attached thereto in a plane through the centerline of the drill string. An arrangement of this type is disclosed in U.S. Pat. No. 3,189,103 to K.A.G. Attebo et al. However, the arrangement of Attebo requires two chains and sprocket sets and the mast structure itself, in order to accommodate the disclosed arrangement, cannot have any lateral support members along the side thereof adjacent to the drill motor. This arrangement is not only complex but furthermore does not permit the mast structure to be as rigid and strong as desired.

SUMMARY OF THE INVENTION

The present invention provides for an improved mounting arrangement for a percussion rock drill movably supported on an elongated feed support or mast. With the mounting arrangement of the present invention the feed force exerted on the percussion drill motor and elongated drill string is imposed on the drill motor proper in coaxial alignment with the longitudinal axis of the drill string. The drill mounting arrangement of the present invention further provides a coaxial or centered feed force to be applied to the drill string wherein a single flexible feed chain or cable centrally positioned within the mast is used as the feeding means.

The improved mounting arrangement of the present invention also provides for a percussion rock drill to be slidably mounted on an elongated mast in a manner which provides for the percussion drill motor proper to be self-aligning and less subject to lateral forces which would tend to impose a bending load on the extension drill rod members making up the drill string.

The improved rock drill mounting arrangement of the present invention additionally provides means for direct sensing of the feed force applied to the drill string. In the drill mounting arrangement of the present invention a pressure fluid sensor is positioned on a feed

force transmitting frame so as to transmit directly the drill feed force from the frame to the drill motor proper. The pressure fluid force sensor is advantageously used to indicate to the drill operator the feed force on the drill string.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of a mobile rock drill rig including the rock drill mounting arrangement of the present invention;

FIG. 2 is a fragmentary side view of the rock drill motor and force transmitting frame showing the connection between the drill motor and the frame;

FIG. 3 is a front elevation of the force transmitting frame with the drill motor shown in phantom;

FIG. 4 is a section taken along the line 4—4 of FIG. 1;

FIG. 5 is a section taken along the line 5—5 of FIG. 1; and

FIG. 6 is a perspective view of the force transmitting frame.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 a drilling apparatus comprising a mobile rock drill rig is illustrated and generally designated by the numeral 10. The drill rig 10 includes a crawler type undercarriage 12 suitably supporting an engine 14 which in turn is drivably connected to fluid power pumps 16 for supplying pressure fluid to operate the drill rig. The drill rig 10 also includes an elongated feed support or mast 18 shown in a substantially vertical or erect position in FIG. 1. The mast 18 is pivotally connected to the undercarriage 12 at 20 and is operable to be lowered from the working position shown to a substantially horizontal position by a pair of pressure fluid operated cylinder type actuators 22, one shown.

The mast 18 is an elongated structure comprising standard structural steel members welded together to form a hollow box shaped support, see FIGS. 4 and 5. The mast 18 includes guide means comprising elongated spaced apart channel members 24 facing inwardly one toward the other and forming two corners of the substantially rectangular cross section of the mast. The other two corners are formed by elongated L-shaped structural members 26. The members 24 and 26 are interconnected by an arrangement of tubular steel supports 28, 30, 32, and 34 forming a trusslike structure of substantial rigidity.

Referring to FIG. 3 also, the mast 18 includes a sprocket 36 rotatably supported near the top of the mast and a second sprocket 38 mounted adjacent to the lower end or bottom of the mast. The sprocket 38 is suitably mounted on a rotatable shaft 40 which is drivably connected to a pressure fluid operated rotary motor 42. The sprockets 36 and 38 are operable to support an elongated chain 44 which is trained over the sprockets and is positioned to be equidistant from and between the spaced apart channel members 24. The chain 44 is operable to be reversibly driven by the motor 42 for feeding a drill motor up and down the mast 18 in a manner to be explained further herein.

The drill rig 10 also includes a fluid operated percussion drill motor 46 which is slidably mounted on the mast 18. The drill motor 46 is operable to deliver per-

cussion blows to a drill string 48 made up of elongated slender pipe sections 50 coupled end to end and having one end connected to a shortened pipe section 52 inserted in the lower end of the drill motor. The opposite end of the drill string includes a suitable bit, not shown, for delivering the percussion blows to the earth to form the hole 54. In a manner well known the drill motor 46 is also operable to rotate the drill string 48 about the longitudinal central axis 49 to facilitate drilling of the hole 54. The drill string 48 is journaled by a suitable centralizer 56 for guiding the slender column formed by the coupled pipe sections.

The drill motor 46 is characterized by supporting means including portions 58 and 60 which respectively include pairs of spaced apart lugs 62 and 64, FIGS. 4 and 5. The arrangement of both pairs of lugs is substantially the same as for the lugs 64 shown in FIG. 5. Each pair of lugs includes cylindrical gudgeons 66 extending laterally from the drill motor 46 into members comprising bearing blocks 70 which are provided with suitable bores 68 for receiving the gudgeons. The bearing blocks 70 are dimensioned to be close fitting but slidable in the guide means formed by the channel members 24 as shown in FIG. 5. The gudgeons 66 are retained in the lugs by retaining screws 72 but are slidably journaled in the bores 68 whereby the drill motor may undergo some lateral movement between the channel members 24 and with respect to the drill string longitudinal axis 49. Interposed between each lug and bearing block are pairs of back-to-back resilient members comprising conical spring washers 74. The spring washers 74 operate to "center" the drill motor laterally with respect to the mast 18 and chain 44 but provide for some self-aligning or lateral freedom of movement to reduce any bending loads on the drill string 48. The mounting arrangement for the drill motor 46 shown in FIG. 5 which shows the portion 60 having the lugs 64 is substantially similar to the portion 58 having lugs 62 thereon. The lugs 62 also have gudgeons extending laterally into bearing blocks 70 and spring washers 74 are also used to "center" the drill motor.

As will be noted from the drawings the drill motor 46 is not connected directly to the feed chain 44. In the drill mounting arrangement of the present invention there is provided feed force transmitting means characterized by a frame generally designated by the numeral 76. The force transmitting frame 76 comprises an elongated member 78 formed of a standard structural steel I-beam shape. The lower end of the member 78 includes an integral portion 80 having an elongated slot 82 formed therein. The portion 80 also includes a hole 84 for suitably connecting the frame to one end of the feed chain 44. The opposite end of the frame 76 is similarly connected to the other end of the feed chain 44 at 85, FIG. 1. The frame 76 includes laterally projecting portions 86 and 88 fixed to the member 78. The portions 86 and 88 are adapted to have laterally extending cylindrical gudgeons 90 mounted thereon. The gudgeons 90 extend into bearing blocks 92 similar to the bearing blocks 70 which guide the drill motor 46. The bearing blocks 92 are also slidable in the channel members 24 as shown in the drawings.

Referring to FIGS. 1, 3 and 6, the force transmitting frame 76 includes a transverse plate 94 supported by and welded to the frame portions 88 and suitable gus-

sets 96. The plate 94 is adapted to support pressure fluid force sensing means comprising the cylinder 98 bolted to the plate. The force sensing means includes a piston 100 within the cylinder 98 having a piston rod 102 extending from the cylinder and through the plate 94. The end 104 of the piston rod is operable to engage the upper end of the drill motor 46 for transmitting the feed force exerted by the feed chain 44 to the drill motor and the drill string 50. The force sensing cylinder 98 is positioned on the frame 76 to transmit the feed force to the drill motor 46 coaxially with the longitudinal axis 49 of the drill string to thereby substantially eliminate a tendency for the drill motor to impart a bending load to the drill string. By reducing or eliminating any bending load on the drill string caused by a bending moment or couple the overall stress on the slender drill pipe sections is reduced and higher rates of percussive energy may be transmitted therethrough without danger of breaking the drill pipe sections.

The force sensing cylinder 98 may be used to indicate the feed force exerted on the drill motor 46 whereby the drill operator may operate suitable control means to control the torque exerted by the feed motor 42 to produce a predetermined feed force transmitted by the chain 44 to the force transmitting frame 76. In FIG. 3 a conduit 106 is shown leading to a pressure gauge 108 mounted on a control panel 110 which is located near the drill operator control station, not shown, on the drill rig 10. The conduit 106 and cylinder 98 are suitably charged with fluid such as hydraulic oil. The pressure exerted by fluid contained in the cylinder 98 as a result of force being transmitted from the frame 76 through the cylinder to the drill motor may be read by the operator as an indication of the feed force on the drill string 50. The gauge 108 may be suitably calibrated to read directly in force units.

As shown in FIGS. 2 and 5, the drill motor portion 60 includes a tab 112 which extends into the slot 82 in the frame portion 80. This arrangement comprises means forming a connection between the drill motor and the frame for raising the drill motor up the mast 18 in a direction opposite to the forward feed direction when it is desired to withdraw the drill string from the hole or to add an additional drill pipe section to the drill string. The connection between the drill motor and the frame 76, formed by the tab 112 projecting into the slot 82, is not operable to transmit force to the drill motor from the frame in the forward or downward feed condition.

What is claimed is:

1. In a drilling apparatus:

an elongated support including guide means comprising a pair of spaced apart elongated members; a drill motor mounted on said elongated support and adapted to be reversibly moved along said elongated support;

an elongated drill string connected to said drill motor, said drill string having a central longitudinal axis;

feed means on said elongated support for feeding said drill motor and said drill string along said elongated support;

force transmitting means connected to said feed means and operable to transmit a feed force to said drill motor substantially coaxial with said longitudinal axis of said drill string; and

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support means for said drill motor including at least one pair of cylindrical gudgeons mounted on said drill motor and projecting laterally with respect to said longitudinal axis on opposite sides of said drill motor, support members slidably supported on said spaced apart elongated members and operable to journal said gudgeons, and resilient means interposed between each of said support members and said drill motor for yieldably biasing said drill motor in a centered position between said spaced apart elongated members.

2. In a drilling apparatus:

an elongated support;

a drill motor including support means for supporting said drill motor on said elongated support for reversible movement along said elongated support; an elongated drill string connected to said drill motor, said drill string having a central longitudinal axis;

feed means on said elongated support for feeding said drill motor and said drill string along said elongated support; and,

force transmitting means connected to said feed means and disposed on said elongated support independent of said support means, said force transmitting means being engaged with said drill motor for transmitting a feed force to said drill motor substantially coaxial with said longitudinal axis of said drill string.

3. The invention set forth in claim 2 wherein:

said feed means includes elongated flexible means mounted on said elongated support and connected to said force transmitting means for feeding said force transmitting means reversibly along said elongated support.

4. The invention set forth in claim 3 wherein:

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said elongated flexible means comprises a feed chain centrally positioned on said elongated support.

5. The invention set forth in claim 2 wherein:

said elongated support includes guide means and said force transmitting means includes support means adapted to be supported by said guide means for reversible movement along said elongated support.

6. The invention set forth in claim 5 wherein:

said guide means comprises a pair of spaced apart elongated members, said support means for said drill motor includes at least one pair of cylindrical gudgeons mounted on said drill motor and projecting laterally with respect to said longitudinal axis on opposite sides of said drill motor, and said drill motor includes support members slidably supported on said spaced apart elongated members and operable to journal said gudgeons.

7. The invention set forth in claim 5 wherein:

said force transmitting means includes a frame, means mounted on said frame operable to engage said drill motor for transmitting a feed force to said drill motor and said drill string substantially coaxial with said longitudinal axis, and means on said frame operable to engage said drill motor for moving said drill motor and said drill string along said elongated support in a direction opposite to the direction of said feed force.

8. The invention set forth in claim 7 wherein:

said means mounted on said frame for transmitting a feed force to said drill motor comprises force sensing means operable to sense the magnitude of said feed force transmitted from said frame to said drill motor, said force sensing means comprising a pressure fluid cylinder and piston mounted on said frame for engagement with said drill motor coaxial with said longitudinal axis of said drill string.

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