

Boring Device and Torque Support for a Boring Device

The invention relates to a boring device for creating earth bore holes in accordance with the generic part of claim 1. The invention also relates to a torque support for a boring device to tap off the torque at a point on a boring rod in an earth bore hole remote from a boring tool.

In the creation of bore holes and core drillings, especially by means of roller bits used as the boring tool, it is necessary to constantly clean the boring tools used for loosening the earth in its path of drilling debris, to transport this debris away from the bottom of the bore hole and thus effect optimum continuance of the drilling process.

For this, it is customary to purge the boring head carrying the boring tools directly with either air or a flushing fluid, or indirectly by means of a pneumatic lifting process or by means of a suction drilling process. In so doing, the air or the purging fluid is guided by way of a channel along the boring string into a hose from the working plane to the bottom of the bore hole. The differing relative movement between the standing pump or a compressor and the rotating boring string rotating within the boring tool is dealt with by means of a purging head on the outer-lying rotary drive. These known boring devices for creating earth bore holes feature a boring string, a torsionally rigid boring tool attached thereto, a drive for rotational driving of the boring string, a pump mechanism

and a fluid line, which extends from the pump mechanism to the boring tool in order to generate a fluid flow by means of the pump mechanism at the boring tool.

With such a boring device, it is disadvantageous that the purging medium under pressure must be conveyed by way of a purging head to the boring tool. Sealing problems at the purging head and a corresponding loss of pressure can thus occur. In addition, with boring devices for intermittent boring operations, such as for Kelly boring, a labour-intensive installing and dismantling of purging lines is necessary for each boring cycle.

It is the object of the invention to create a boring device with which simple and energy-saving removal of drilling debris from the boring tool is possible. Another object is to provide a torque support for a boring device through which torque for the driving of an ancillary unit can be tapped off from a boring string in an earth bore hole.

The first stated object is resolved according to the invention by a boring device having the characterising features of claim 1.

Provisions according to the invention are:

- that the pump mechanism features a hose, which is held to the boring string to prevent rotation and is arranged at least partially around this at a constant distance,
- that a pump stator is provided, which on one side is located to enable rotation to be effected around the boring string and on the other side is located against a wall of the earth bore hole to prevent rotation,

- that the pump stator features a stator arm extending radially to the boring string, which is arranged between the boring string and the hose, and
- that the stator arm lies zonally squeezing against the hose, wherein the stator arm brushes over the hose rotating with the boring string.

According to a basic concept of the invention a simple hose pump is installed behind the boring tool in the bore hole. The pump is thus driven by the rotation of the boring string, for example by a Kelly rod. The pump mechanism features a hose, which is attached to the boring string by way of a suitable retaining device. The hose thus rotates with the boring string and forms a rotor of the pump mechanism. Upon rotation of the boring string the hose passes by the stator arms of the stator lying squeezed up against the hose, the stator being supported against the wall of the bore hole to prevent rotational movement. Through the relative movement between the stator and the rotor, a pumping action is generated during drilling. Depending on the direction of rotation, such a pressure can be induced for purging the boring tool or suction induced for sucking up drilling debris.

Whilst one end of the hose is connected to a fluid line leading to the boring tool, the other end of the hose is connected to a fluid reservoir, which can be ambient air or purging liquid. The end of the hose can also be connected to tank arranged outside of the bore hole. In any event, energy transfer from an additional fixed energy generator to the rotating boring tool for the boring device is not necessary in accordance with the invention.

A preferred arrangement of the invention exists in that the pump stator is located axially fixed on the boring string. The pump stator can thus follow the hose during continuance of boring.

Provision is made for a particularly simple operation of the pump mechanism to be effected, whereby the pump stator features a torque support, which, during boring, lies tightly against the wall of the earth bore hole and can slide in longitudinal direction of the boring string. The pump stator can be mounted particularly easily upon the boring string and follow with the boring string according to the progress of the boring operation.

With regard to adequate dimensioning and performance of the pump mechanism, it is preferred, in another embodiment of the boring device in accordance with the invention, that the boring tool features a core boring pipe having a channel, and that the hose and the channel are connected to form the fluid line.

Particularly good progress is therefore guaranteed during drilling if a tank is arranged on the boring tool for accepting purging fluid and drilling debris, and a pipe is provided between the tank and an earth excavation device on the boring tool. Any drilling debris can, for example, be sucked up into the tank by this pipe, the tank being able to be emptied upon removal of the boring tool from the prepared bore hole. The tank can also be used as a purging fluid reservoir.

Another preferred embodiment of the invention exists in that the stator arm features a roller on its free end, squeezing the hose, which is located to rotate

around a roller shaft parallel to the longitudinal direction of the boring string. Because of the roller, any wear occurring on the hose, caused by relative movement in relation to the stator arm, is prevented to a large extent.

Provision is made for generating a uniform pressure where the pump stator has a plurality of uniformly distributed stator arms around its periphery. In particular, two stator arms are provided, arranged at an angle of 180° in relation to each other.

In another embodiment in accordance with the invention, it is advantageous that a plurality of pump mechanisms is arranged on a boring string. In this case, a plurality of hoses and a plurality of stator arms are arranged one behind the other in axial direction. By means of a plurality of pump mechanisms a relatively high pump capacity can be set. For this, a plurality of hoses can also be placed one above the other on a common carrier serving as a rotor.

The second stated object of the invention is resolved by a torque support for a boring device for tapping off torque at a point on a boring string in an earth bore hole remote from a boring tool, having:

- a main body, which features an orifice arranged centrally for the passage of the boring string,
- a bearing mechanism at the orifice for the rotatable location of the main body on the boring string,
- at least three holders arranged on the main body pitched at distance from each other, which holders extend away radially to the longitudinal axis of the boring string passing through the orifice,

- at least one roller body at each holder, to which the roller body is located to enable rotation around a shaft, which are arranged perpendicular in each case to the longitudinal axis of the boring string passing away through the orifice and are tangential to its direction of rotation on the holders, and
- a pressure device for generating a pressure force, which basically presses the holders with the roller bodies away radially out from the main body.

Based on the torque support in accordance with the invention, the torque generated by the boring string in the effectual zone can be dissipated during the production of earth bore holes. Through the torque support being fitted to the boring string, which, incidentally, is stationary in relation to the boring string, mechanical power can be tapped, which, if need be, can be utilised to power any necessary secondary drives or ancillary units. Such an ancillary unit can, in particular, be a pump, which is used to transport away drilling debris from the bottom of the bore hole. The driving power of the boring device or the powered rotating head is normally greater than the power needed for the boring process. Consequently, it is possible, without modifications to the unit, to convey the required percentage of this power needed for the secondary drive by way of the boring string itself to the point of subjection.

In contrast to conventional devices, for which a required driving power for the drive is fed to an ancillary unit in the form of electrical, pneumatic or hydraulic energy from a point external to the bore hole, the torque support in accordance with the invention clearly offers advantages. As a consequence, the expensive form of transmission of energy from a stationary energy generator to a rotating tool is not needed. Furthermore, since, the torque support in

accordance with the invention can be arranged in the bore hole behind the boring tool, the problem of adaptation regarding the power line length in the deepening the bore is not applicable, particularly as Kelly rods are used when drilling.

Provision is made in accordance with the invention for adaptation to various diameters of bores where the holders are able to slide in relation to the main body.

Automatic adaptation to fluctuations in diameter is achieved by an embodiment of the invention in which the compression device has a spring mechanism, which presses the holders together with the roller bodies by a defined compression force against the wall of the earth bore hole. The torque support in accordance with the invention is thus held constantly by spring force in contact with the piped or non-piped wall of the earth bore hole. Variations in diameter, for example, in the transition from the bore pipe to the runout of the bore hole can be compensated for by the radial actuation stroke of the roller bodies.

A preferred pivoting-out of the holders is therefore achieved in which the holders are located to pivot in each case around a pin on the main body, which is orientated parallel to the longitudinal axis of the boring string.

This form of design is further developed in an advantageous manner in which each holder has a radially projecting arm projecting inwards, and that between the lever arm and the main body is arranged a compression spring, which presses the holder in its radial outer-lying position. The transmission of torque in

accordance with the invention is thus accomplished on the principle of self-locking, due to friction in circumferential direction. In so doing, it differs from the conventional machine function of "free-running", which, in axial direction, utilises no self-locking through the use of roller bodies. The pressure force generated by the compression springs is set to keep friction forces of the torque support as low as possible in the direction of thrust. For example, during drilling when using Kelly bore rods the oscillating motion is scarcely noticeable during the drilling operation.

In another embodiment in accordance with the invention provision is made to the effect whereby there is a stop incorporated for each holder on the main body, against which the holder lies during drilling. The stop thus fixes the holders in their position. In reversing the direction of rotation of the boring string a lever arm of the holder lying against a stop pivots away from the stop, so that the self-locking action of the mechanism is released. As a result, a drive, for example a pump, is only locked in one permitted direction of rotation. Furthermore, with this design type the torque support cannot be released from the bracing strain through brief back rotation of the boring string prior to upward movement.

To set the maximum permitted diameter to which the roller bodies may be swung out, a torque support in accordance with the invention has been further developed such that an adjustment mechanism is provided at each stop, with which the swing of the respective holder can be set during drilling.

The invention is explained further with the aid of preferred embodiments, which are depicted schematically on the drawings. Depicted on the drawings are:

Fig. 1 a cross sectional view of boring device in accordance with the invention in an earth bore hole;

Fig. 2 a sectional presentation in accordance with section A-A in Figure 1;

Fig. 3 a sectional presentation in accordance with section B-B in Figure 1;

Fig. 4 a sectional presentation in accordance with section C-C in Figure 1;

Fig. 5 a scrap sectional plan view upon a torque support in accordance with the invention in an earth bore hole;

Fig. 6 a sectional presentation in accordance with section A-A in Figure 5; and

Fig. 7 a sectional presentation in accordance with section B-B in Fig. 5.

According to Figure 1, a boring device 10 in accordance with the invention features a pump mechanism 11. This is fitted to a boring string 13, which, for the embodiment depicted, is a Kelly boring rod, fitted at a point that lies within a prepared earth bore hole 20 in the ground 21. On the boring string 13 is also fitted a boring tool 14 beneath the pump mechanism 11. In the depicted embodiment the boring tool 14 is designed as cylindrical shaped core boring pipe having roller bits 22 for excavating the ground.

A fluid line 12 is routed from the pump mechanism 11 by way of a channel 19 on the boring tool 14 to the roller bits 22 arranged on the head end. The roller bits 22 are purged of drilling debris 24 by a flow of fluid directed as per arrow P2.

The drilling debris 24 is conveyed upwards into a tank 26 on the boring tool 14 by way of a pipe 25 fitted on the boring tool 14 parallel to the boring string 13 as per the arrows P3 and P4. From there the drilling debris 24 can be removed during the extraction of the boring tool 14 from the earth bore hole 20.

The arrangement of the roller bits 22 and the suction pipe 24 on the periphery of the boring tool 14 can be seen in the view in accordance with Figure 4.

The construction and the function of the pump mechanism 11 is further explained with the aid of Figures 1, 2 and 3. As a rotor of the pump mechanism 11 a hose 15 is used, which is fitted so as not to rotate over a carrier 16 on the boring string 13. The hose 15 surrounds the boring string 13 in an essentially part-circular shape at a constant distance. An outlet 18 of the hose 15 facing downwards and is connected to the fluid line 12. In contrast to this, an inlet 17 of the hose 15 is directed upwards in the direction away from the bore hole, in order to transfer a fluid in the direction of arrow P1. The fluid may be air or a purging liquid.

To induce flow in the hose 15 a pump stator 30 is provided having two stator arms 32 extending outwards radially from a bearing device 31. On the free end of the two stator arms 32 is arranged in each case a roller 33, which lies against the flexible hose 15 and squeezes it. The rollers 33 are rotatable by means of shafts arranged parallel to the longitudinal axis of the boring string 13 and located on the stator arms 32.

The pump stator 30 is located on the boring string 13 by means of the bearing device 31 to enable rotation to occur but not any axial movement. The pump

stator 30 is supported against a wall 27 of the earth bore hole 20 and prevented from rotating by said wall by means of a torque support 40 having four holders 41 arranged as right-angles to each other, which extend radially outward from the bearing sleeve 31. To axially move the torque support 40 and the pump stator 30 in the earth bore hole 20 in accord with the progress in depth of the drilling operation, roller bodies 42 are arranged on the free ends of the four holders 41, the roller bodies in each case being able to rotate around a horizontally orientated shaft 43. In addition the holders 41 can move radially by way of a respective spring mechanism 44 to compensate for fluctuations in the diameter of the earth bore hole 20.

Between the pump stator 30 thus supported and the hose 15 rotating with the boring string 13 as a pump rotor there is a relative motion. Due to this the rollers 33 on the stator arms 32 move across the squeezed surface of the hose and compress in this manner the fluid inside the hose in the direction of the outlet 18 into the fluid line 12. In so doing, adequate fluid pressure is attained in accordance with the invention at a relatively slow speed of rotation, in order to purge the boring tool 14 free of any drilling debris 24. Any additional transfer of energy for setting the fluid pressure is not necessary. To increase the pump capacity, additional pump mechanisms 11 can be provided if need be one behind the other on the boring string 13. To accomplish this, an appropriately designed connection 45 made to the boring string 13 is to be effected, wherein additional pump mechanisms 11 can be attached in a simple manner to the drilling string 13.

In the depicted form of design having the direction of rotation shown by the applicable arrows D fluid flow is generated down to the boring tool 14. In

reversing the direction of rotation a sub-pressure can even be induced in the fluid line 12 with the depicted boring device 10, the sub-pressure causing the drilling debris 24 to be sucked away up in the direction towards the pump mechanism 11 by way of the fluid line 12.

In conjunction with the Figures 5 to 7 a torque support 140 in accordance with the invention is explained, which can be used for the aforementioned boring device. The torque support 140 comprises a main body 145, which in respect of a boring string 113 passed through a central orifice 156 is located to rotate by means of bearings 119. The bearings 119 are thrust and radial bearings, so that axial displacement of the main body 145 in relation to the boring string 113 is prevented.

The main body 145 is constructed from two plates 146, 147 arranged parallel to each other, between which are fitted holders 141 having roller bodies 142.

All three holders 141 distributed uniformly over the periphery of the main body 145 feature for the location of the roller bodies 142 a shaft 143, which is perpendicular to the longitudinal axis of the boring string 113 and which points in the direction of rotational motion of the boring string 113. The necessary force for moving the torque support 140 in the direction of drilling V is therefore small.

The holders 141 are pivotal in each case by way of a pin 148 located on the main body 145. The centre point of the axis of the respective pin 148 is offset by an amount e in relation to a radial line 149 running from the longitudinal axis of the boring string 113 to the centre point of the roller body 142, and indeed opposes the rotational direction D of the boring string 113. Due to the

constructive design in creating the eccentricity e the magnitude of the pressing and frictional forces can be easily influenced.

In order to create the contact of the roller bodies 142 with the wall 27, which is a bore pipe in the depicted design embodiment, during entry into the earth bore hole 20 in the ground 21, a compression device 144 is provided having compression springs 150. These are supported on one side against a support plate 151 on the main body 145 and push on the other side against a lever arm 152 projecting radially inwards of the respective holder 141.

A certain spring pre-loaded force of the holders 141 therefore introduces the phase of self-locking.

To set the maximum path of pivot of the holders 141 is provided an adjustment mechanism 153. This comprises a stop 154 securely fixed to the main body 145 and the set screws 155 situated therein. In rotating of the torque support 140 in rotational direction D, the lever arms 152 press against the set screws 155, so that the holders 141 with the roller bodies 142 are fixed in their radially projecting position. In reversal of the direction of rotation the holders 141 are released from their tensioned position against the direction of pressure of the compression springs 150. By way of suitable connecting devices, cantilevers can be fitted to the torque support, the cantilevers acting as the stator for tapping off of torque in respect of a rotor.

CLAIMS

1. Boring device for the producing of earth bore holes having

- a boring string (13),
- a torsionally rigid boring tool (14) fitted thereto,
- a drive for rotationally driving the boring string (13),
- a pump mechanism (11) and
- a fluid line (12), which extends from the pump mechanism (11) to the boring tool (14), in order to produce a fluid flow by means of the pump mechanism (11) to the boring tool (14),

characterised in

- that the pump mechanism (11) features a hose (15), which is held to the boring string (13) to prevent rotation and is arranged at least partially around this at a constant distance,
- that a pump stator (30) is provided, which on one side is located to enable rotation around the boring string (13), and on the other side is located against a wall (27) of the earth bore hole (20) to prevent rotation,
- that the pump stator (30) features a stator arm (32) extending radially to the boring string, which is arranged between the boring string (13) and the hose (15), and
- that the stator arm (32) lies zonally squeezed against the hose (15), wherein the stator arm (32) brushes over the hose (15) rotating with the boring string (13).



2. Boring device according to claim 1, characterised in that the pump stator (32) is located axially fixed to the boring string (13).
3. Boring device according to claim 1 or 2, characterised in that the pump stator (32) features a torque support (40) (40) which in rotational direction lies stationary against the wall (27) of the earth bore hole (20) during drilling and is slidable in longitudinal direction of the boring string (13).
4. Boring device according to claims 1 to 3, characterised in that the boring tool (14) features a core bore pipe having a channel (19) and that the hose (15) and the channel (19) are connected to form the fluid line (12).
5. Boring device according to any of the claims 1 to 4, characterised in that on the boring tool (14) is arranged a tank (25) for accepting purging fluid and drilling debris (24) and that a pipe (25) is provided between the tank (26) and a ground excavation device on the boring tool (14).
6. Boring device according to any of the claims 1 to 5, characterised in that the stator arm (32) features on its free end squeezing the hose (15) a roller (33), which is located to enable rotation around a roller shaft (34) parallel to the longitudinal axis of the boring string (13).
7. Boring device according to any of the claims 1 to 6, characterised in that the pump stator (30) features a plurality of stator arms (32) distributed uniformly over its periphery.



8. Boring device according to any of the claims 1 to 7, characterised in that a plurality of pump mechanisms (11) are arranged on the boring string (13).
9. Torque support for a boring device, especially according to any of the claims 1 to 8 for tapping off a torque at a point on a boring string in an earth bore hole remote from a boring tool, having
- a main body (145), which features an orifice (156) arranged centrally for the passage of the boring string (13),
 - a bearing mechanism (119) at the orifice (156) for the rotatable location of the main body (145) on the boring string (113),
 - at least three holders (141) arranged on the main body (145) pitched at distance from each other, which holders extend away from the main body (145) radially to the longitudinal axis of the executing boring string (13) passing through the orifice (156),
 - at least one roller body (142) at each holder, to which the roller body (142) is located to enable rotation around a shaft (143), which are arranged perpendicular in each case to the longitudinal axis of the boring string (113) and are tangential to its direction of rotation on the holders (141), and
 - a compression device (144) for generating a pressure force, which basically presses the holders (141) with the roller bodies (142) away radially out from the main body (145).
10. Torque support according to claim 9, characterised in that the holders (141) are slidable in relation to the main body.



11. Torque support according to claim 9 or 10, characterised in that the compression device (144) features a spring mechanism, which presses the holders (141) with the roller bodies (142) with a defined compressive force against the wall (27) of the earth bore hole (20).
12. Torque support according to claims 9 or 11, characterised in that the holders (141) are pivotally located in each case on the main body (145) around a pin (148), which is orientated parallel to the longitudinal axis of the boring string (113).
13. Torque support according to any of the claims 9 to 12, characterised in that each holder (141) features a lever arm (152) projecting radially inwards and that between the lever arm (152) and the main body (145) is arranged a compression spring (150), which presses the holder (141) into its radial outer-lying position.
14. Torque support according to any of the claims 9 to 13, characterised in that a stop (154) is provided for each holder (141) on the main body (145), to which the holder (141) lies during drilling.
15. Torque support according to claim 14, characterised in that an adjustment mechanism (153) is provided at each stop (154), with which the swing of the respective holder (141) can be set during drilling.

