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(54) **DRILLING APPARATUS**

BOHRGERÄT

APPAREIL DE FORAGE

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EP-A- 0 124 290 EP-A- 0 244 986
AU-A- 8 014 387 AU-B- 467 150

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Description

The present invention relates to a drilling apparatus, in particular for drilling of holes preferably in soil consisting essentially of glacier deposits or comparatively soft rocks, said drilling apparatus comprising a drilling pipe with a cutter head placed on the front end, the drilling pipe consisting of two coaxial pipes forming an interspace, through which a drilling medium such as water or air can be introduced and removed together with chips from the drilling through the unobstructed clear of the inner pipe, the cutter head comprising a number of hard metal bits and nozzles in between, through which the drilling medium can flow under pressure, and furthermore a number of radially inwards directed nozzles at a short distance from the cutter head and a number of ejector nozzles, which is directed obliquely inwards in a direction away from the cutter head.

In the known apparatuses a number of ports opens into the clear of the coaxial pipes forming the drill string. Through the ports jets of pressurized fluid are directed into the inner pipe. The ports are directed upwards so that the jets of pressurized fluid may support transport of the material up the inner pipe. The jets also have the effect of decomposing the material into smaller particles, which more easily will follow the flow of drilling fluid through the inner pipe. This effect, however, eliminates the possibility taking up a core for analyzing the layers of earth. With the apparatus according to EP-A-0 124 290 the boring head is provided with a cutting edge preventing the formation of a core to be passed through the inner pipe, but according to EP-A-0 244 986 a core for analyzing may be produced. The core may be brought up by means of a sampling tube, which is inserted into the inner pipe of the drill string. This is a complicated procedure requiring extra equipment to be inserted into the drill string.

The object of the invention is to provide a simple arrangement by means of which cores or samples may be taken and brought up through the inner pipe.

According to the invention the drilling apparatus is characterized in that the drilling pipe comprises two coaxial pipe members, which are arranged in an end to end relationship and rotating with respect to each other through a predetermined angle, said pipe members being provided with abutment surfaces, which in one of the positions disconnect the supply of drilling medium to some of the nozzles and in the other position leave the passage open.

By changing the direction of rotation of the drill it is possible to open or close the nozzles directed into the clear of the inner pipe and interrupt the flow through the nozzles. When the nozzles are closed, a core will be formed in the inner pipe, and by changing the direction of rotation of the drill the nozzles are opened and the core will be separated from the earth below the drill head and brought up through the inner pipe.

According to the invention the supply of drilling me-

dium to both the ejector nozzles directed upwards and the radially directed nozzles is disconnected in one of the positions.

The invention will be described in detail in the following with reference to the drawing, in which

Fig. 1 in perspective shows the front part of a drilling apparatus according to the invention partially intersected,

Fig. 2 shows the end surface of one part of a drilling apparatus according to the invention consisting of two mutually angularly displaceable parts, and

Fig. 3 shows the front part of a drilling apparatus consisting of two parts corresponding to the embodiment according to Fig. 2 seen from the side.

Fig. 1 shows the front end of a drill 1 comprising the cutter head. The drill consists of two coaxial pipes 2 and 3, between which an annular interspace, extending over the whole length of the drill, is provided. During the operation of the drill the interspace forms a supply duct for the drilling medium used, said medium being for instance water, drilling mud or air, depending on the type of drilling job and on the type of the assisting equipment accompanying the drill. The two coaxial pipes are at the front end of the drill connected with one another by means of an end wall 4 forming the basis of the cutter head of the drill. The cutter head comprises a number of cutting metal bits 5, which in the embodiment shown approx. have the shape of a champagne cork with a cylindrical shaft 5a inserted into a bore in the end wall 4 running in the axial direction of the drill and having a preferably hemispherically shaped head 5b. The cutting metal bits are preferably placed with a mutual distance along two concentric circles in such a way that the two hemispherically shaped heads of the cutting metal bits extend somewhat outside the inner wall of the inner pipe and the outer wall of the outer pipe 2, respectively. The cutting metal bits 5 are thereby able to break down the soil, in which the drill operates, in a track so wide that a clear is established around the drill.

During the drilling the drill is brought into rotation, the cutter head with the cutting metal bits loosing the soil in front of the drill. If the drill meets a stone or other hard items in the soil layers, these will be crushed by the cutting metal bits. The soil loosened is removed from the area in front of the drill by means of a number of jets of drilling medium, ejected from a corresponding number of essentially axially directed nozzles 6 in the end wall 4. The nozzles 6 may in a preferred embodiment comprise two series of nozzles, in which one series forms an angle of 10-15° inwards towards the axis of the drill and the other series correspondingly forms an angle outwards of 10-15° in relation to the axis of the drill.

The central core, which is during the drilling left in the clear of the inner pipe, is decomposed and transported out of the bore by means of drilling medium,

which is injected partly through a pair of essentially radially inwards directed ejector nozzles 8. Apart from the function of transporting the decomposed material out of the drill through the inner of the drill, the ejector nozzles at the same time control the static pressure on the column of drilling medium on the outside of the drill. It is preferable that only a smaller part of the material cleared is transported upwards along the outer surface of the drill, where it will increase friction and wear of the drill during its rotation. The nozzles 6 are placed in a short distance from the end surface of the drill, while the nozzles 7 may be placed at some distance from the end of the drill. The distance is not critical, but it is preferably comparatively small, so that a zone with a very heavy turbulence is created in the inner of the front end of the drill, said turbulence disintegrate very effectively the material, which is conveyed up into the inner of the drill as the drill penetrates down into the layers of soil, in which drilling is performed. In connection with the drilling apparatus according to the invention the drilled material is brought out of the drill in a disintegrated and suspended condition in the drilling medium used for the drilling. Normally, water is used as drilling medium, said water being supplied at a pressure of 12-20 bar, but the drill can also be used with a drilling mud which is thickened by means of for instance bentonite, or by means of air supplied at a corresponding pressure or at a somewhat higher pressure. In the case of drilling carried out, where ample amounts of water are not available, air is a preferred alternative, which is in practice particularly easy to handle and effective, especially because of the fact that the drill according to the invention operates very quickly in comparison with the known drills, for which reason the necessary consumption of air becomes moderate on account of the shorter drilling time.

According to a particular embodiment of the drilling apparatus according to the invention it may be constructed in such a way that it is possible to take up coherent cores. The embodiment, which is shown in Figs. 2 and 3, comprises a front part of the drill 1 with the nozzles and the cutter head shown in Fig. 3, said front part being rotatable in relation to the remaining shaft of the drill, the front end of which is shown in Fig. 2. The two parts of the drill are connected along a dividing area acting as a valve for the control of the supply of drilling medium to the nozzles directed towards the center of the clear in the inner pipe.

Fig. 2 shows an embodiment of the joint surface 9 on the front part of the drill shaft. The joint surface comprises a pair of keyhole-shaped openings 10 engaging a corresponding pair of studs 11 placed on the end surface 12 of the drill shaft (Fig. 3) cooperating with the joint or abutment surface 9. The studs 11 have a head 14, which may just pass through the enlarged part 15 of the openings 10. After insertion in the openings 10, the studs are locked in the narrow part of the openings 10 by means of set screws 16. The studs 11 cannot pass the screws into the enlarged part, and the two parts of

the drill are thereby safely connected. The dividing area 9 furthermore comprises some holes 17 connected with ducts, which supply the inwards towards the inner of the drill directed nozzles with drilling medium. These holes 17 are placed in front of holes 18 in the end surface 12 in such a way that the holes 17 and 18 are on line in the angular position, which the two parts have, when the studs are in one end of the keyhole-shaped openings, and displaced so much in relation to each other that there is no passage, when the studs 11 are in the position defined by the set screws 16. In the position, in which the nozzles directed towards the clear are closed, the hole 18 is positioned in front of the circle 19 drawn in broken lines. The opening and the closing of the passages through the two set of holes 17 and 18 are controlled by a change of the rotational direction of the drill. In one rotational direction the supply of drilling medium to the nozzles directed inwards towards the clear in the drill is blocked, and if drilling is made with this rotational direction a core of the material, in which the drill penetrates, will form in the inner of the drill. This core may either be taken up together with the drill or by changing the rotational direction of the drill, whereby the radially inwards directed nozzles are provided with drilling medium, which will cut off the core, which will then under normal circumstances be shot up through the inner of the drill by means of a flow of drilling medium introduced through the ejector nozzles. The method described requires when air is used as drilling medium certain precautions to ensure a safe catching of the core, which is on account of the expansion of the air shoot out of the drill pipe like a projectile.

As an alternative to the embodiment shown in Figs. 2 and 3, in which the two mutually rotatable parts are in contact along a surface running perpendicular to the shaft of the drill, the contact surface may also be elaborated in other ways. In particular the contact surface may comprise one or more cylindrical or conical sections, which can guide the two parts radially in relation to each other. When constructing the contact surface with a cylindrical section the need for keyhole-shaped openings does not exist, as the two parts may be interlocked by means of one or more radially extending pins, which are displaceable in oblong holes extending along a part of the circumference of the other part. The valve function is secured in a corresponding way through openings or recesses which are in line with one another in one of the angular positions, and which in the other position are displaced so much mutually that there is no passage between the holes. In both angular positions passage should be allowed through some of the pairs of holes which are connected to the nozzles placed in the end wall, said nozzles ejecting approximately axially directed jets of drilling medium into the interspaces between the cutting metal bits. These holes may have a suitable oblong shape which ensuring a suitable flow cross section in both positions, or they may be elaborated in such a way that the flow cross section is smallest

when the remaining nozzles are blocked and the biggest pressure is available for overcoming the flow resistance.

Claims

1. Drilling apparatus, in particular for drilling of holes preferably in soil consisting essentially of glacier deposits or comparatively soft rocks, said drilling apparatus comprising a drilling pipe with a cutter head placed on the front end, the drilling pipe consisting of two coaxial pipes (2,3) forming an interspace (4), through which a drilling medium such as water or air can be introduced and removed together with chips from the drilling through the unobstructed clear of the inner pipe (3), the cutter head comprising a number of hard metal bits (5) and nozzles (6) in between, through which the drilling medium can flow under pressure, and furthermore a number of radially inwards directed nozzles (7) at a short distance from the cutter head and a number of ejector nozzles (8), which is directed obliquely inwards in a direction away from the cutter head,
characterized in that the drilling pipe comprises two coaxial pipe members, which are arranged in an end to end relationship and rotating with respect to each other through a predetermined angle, said pipe members being provided with abutment surfaces (9,12), which in one of the positions disconnect the supply of drilling medium to some of the nozzles and in the other position leave the passage open.
2. Drilling apparatus according to claim 1,
characterized in that the supply of drilling medium to both the ejector nozzles (8) and the radially directed nozzles (7) is disconnected in one of the positions.

Patentansprüche

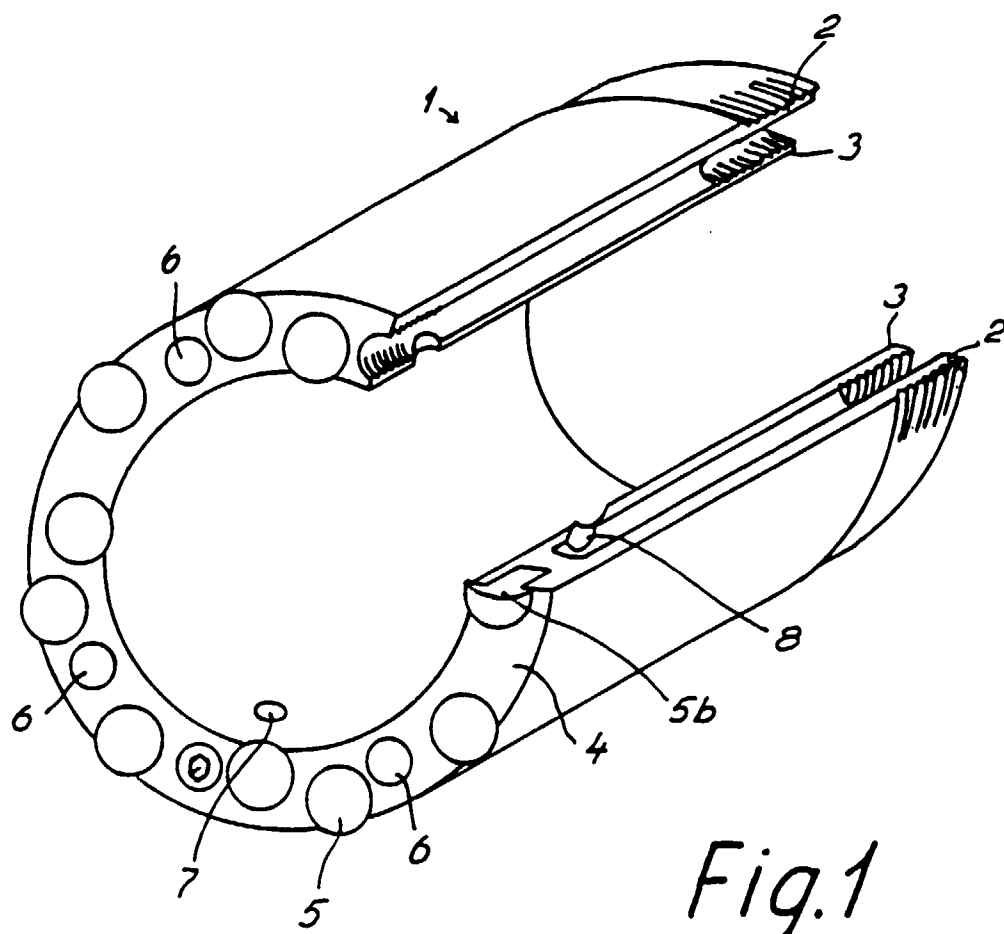
1. Bohrerät, insbesondere zum Bohren von Löchern vorzugsweise im Erdboden, der im wesentlichen aus Moränenablagerungen oder verhältnismässig weichen Gebirgsarten besteht, welches Bohrerät ein Bohrröhr umfasst, das eine am vorderen Ende angeordnete Bohrkronen aufweist, wobei das Bohrröhr aus zwei konzentrischen Röhren (2,3) besteht, die einen Zwischenraum bilden, durch welchen ein Bohrmittel wie Wasser oder Luft eingeföhrt werden kann und zusammen mit Bohrspänen durch die freie Lichtweite des inneren Röhres (3) entfernt werden kann, wobei die Bohrkronen eine Anzahl Hartmetallplättchen (5) und dazwischen angeordneter Düsen (6) umfasst, durch welche das Bohrmittel unter Druck fliessen kann, und weiter eine Anzahl Strahldüsen (8), die schräg nach innen von der

Bohrkronen weggekehrt gerichtet sind, dadurch **gekennzeichnet**, dass das Bohrröhr zwei koaxiale Röhrenteile umfasst, die im Anschluss an einander angeordnet sind und die unter einem vorausbestimmten Winkel zueinander rotieren, welche Röhrenteile mit Widerlagerflächen (9,12) versehen sind, die in einer der Winkelstellungen die Zufuhr von Bohrrmedium zu einigen der Düsen einstellen und in der anderen Stellung den Durchgang offen lassen.

2. Bohrerät nach Anspruch 1, dadurch **gekennzeichnet**, dass die Zufuhr vom Bohrrmedium zu sowohl den Strahldüsen (8) als auch zu den radial gerichteten Düsen (7) in einer der Stellungen eingestellt ist.

Revendications

1. Appareil de forage, en particulier pour le forage de trous préférablement en terre essentiellement composée d'alluvions glaciaires ou de roches relativement tendres, ledit appareil de forage comprenant un tuyau de forage avec une tête à forer sur le bout antérieur, le tuyau de forage étant composé de deux tuyaux (2, 3) coaxiaux formant un espacement (4), par lequel un médium de forage, tel que de l'eau ou de l'air, peut être introduit et enlevé avec la coupe du forage par l'espace libre du tuyau (3) intérieur, la tête à forer comprenant un nombre de tranchants en carbure et de buses (6) entre ceux-ci, par lesquelles le médium de forage peut couler sous pression, et de plus un nombre de buses (7) axialement orientées vers l'intérieur à une petite distance de la tête à forer et un nombre de buses (8) à éjecteur qui sont obliquement orientées vers l'intérieur dans une direction loin de la tête à forer, **caractérisé** en ce que le tuyau de forage comprend deux éléments coaxiaux de tuyau qui sont placés bout à bout et pivotables l'un par rapport à l'autre par un angle prédéterminé, lesdits éléments de tuyau étant pourvus de surfaces d'appui (9, 12) qui dans l'une des positions interrompent le courant de médium de forage à quelques-unes des buses et dans l'autre position laissent le passage ouvert.
2. Appareil de forage selon la revendication 1, **caractérisé** en ce que le courant de médium de forage dans l'une des positions est interrompu à la fois aux buses (8) à éjecteur et aux buses (7) radialement orientées.



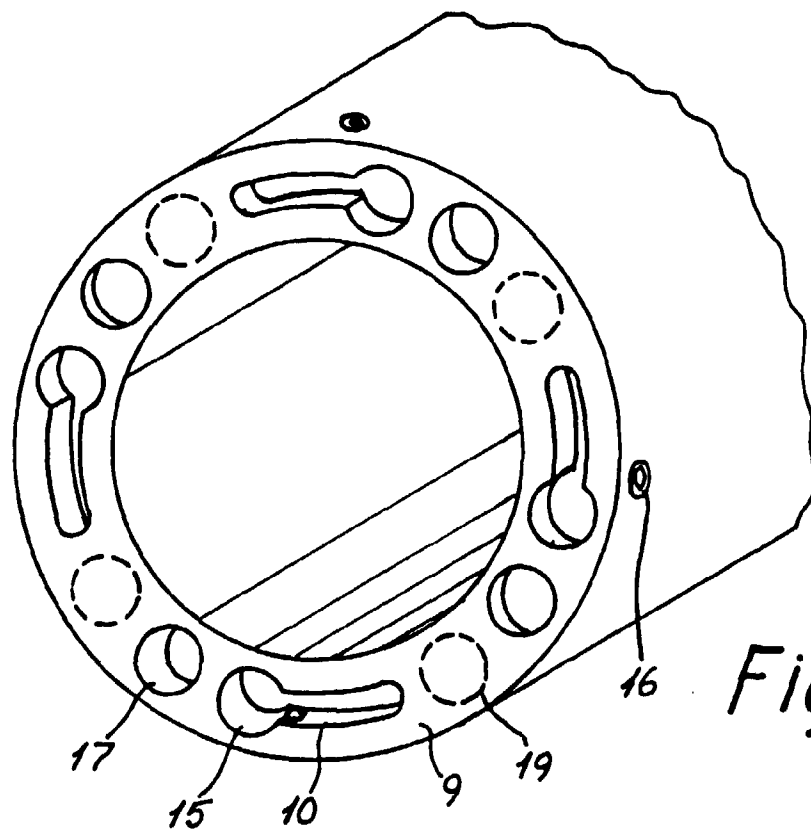


Fig. 2

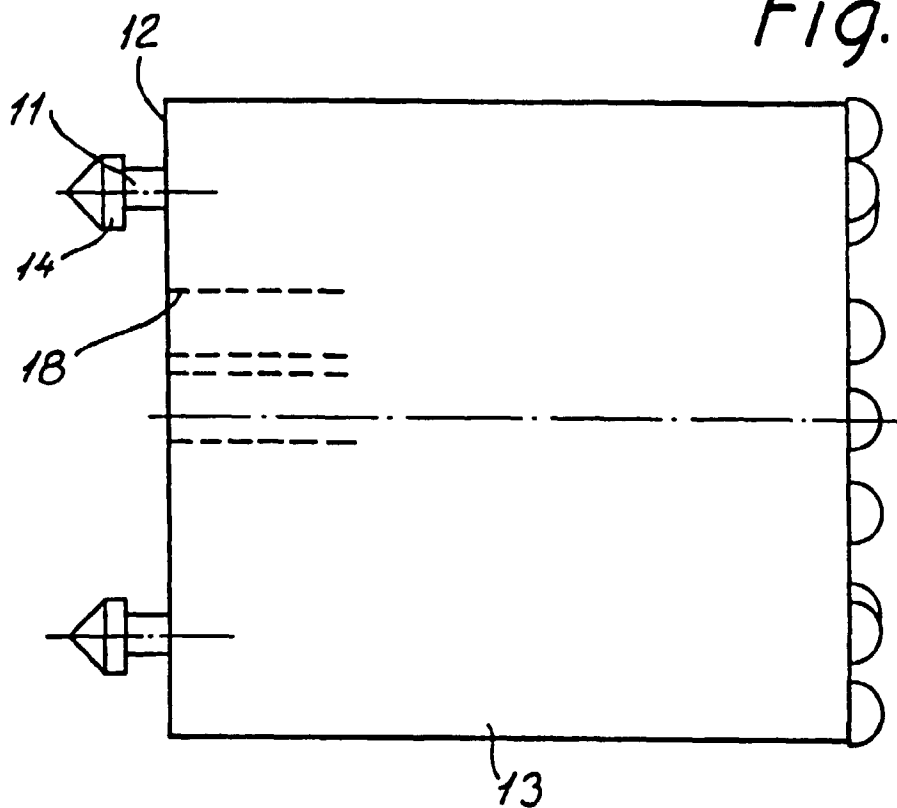


Fig. 3