United States Patent

Van Der Wijden

[15] **3,670,830**

[45] **June 20, 1972**

[54] DRILLING APPARATUS

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[22] Filed: **April 9, 1970**

[21] Appl. No.: **26,877**

[30] **Foreign Application Priority Data**

April 9, 1969 Great Britain.....18,144/69

[52] **U.S. Cl.**.....**175/52,** 175/243, 175/383, 285/DIG. 21

[51] **Int. Cl.**.....**F21b 19/14,** F21b 25/00

[58] **Field of Search**.....175/52, 382, 383, 422, 327; 285/18, DIG. 21, 320

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Attorney—Waters, Roditi, Schwartz & Nissen

[57] **ABSTRACT**

A drilling apparatus is deposited on a submerged floor for cutting a borehole in the floor and removing samples therefrom. The drilling apparatus has a drilling head which is detachably coupled to a string of pipes all detachably connected together by connecting devices which are engageable by axial pushing of the pipes together. The pipes carry inner tubes which cooperatively form an inner annular cavity and a core member is detachably connected to the lowermost inner tube of the drill string by spring-loaded latches. When a core sample is in the core tube it is detached by fluid pressure in the space between the outer pipes and the inner tubes and the core barrel is then pumped upwardly and stored in a turntable containing further drill pipes and core barrels. A further drill pipe is connected in the string and a further core barrel is dropped into the inner tubes of the string and connected to the lowermost inner tube pressurizing fluid in the inner tubes.

19 Claims, 11 Drawing Figures

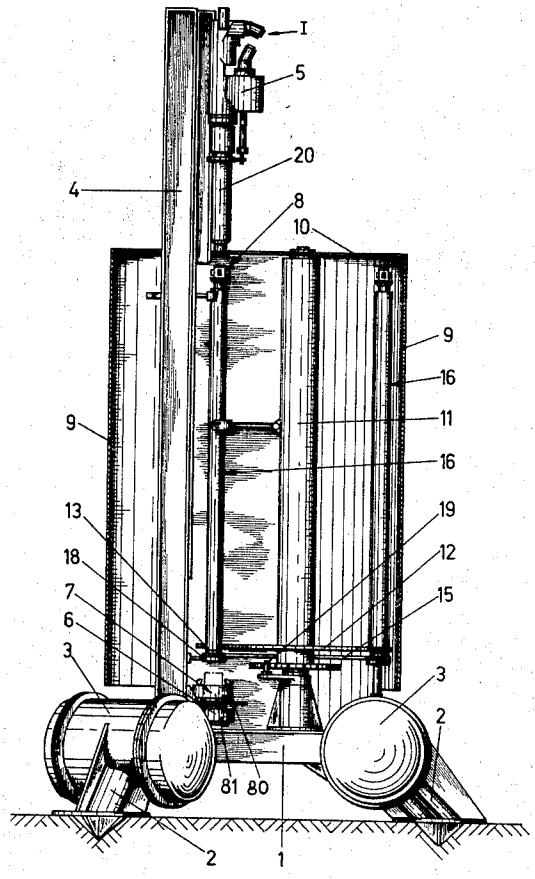


Fig. 1

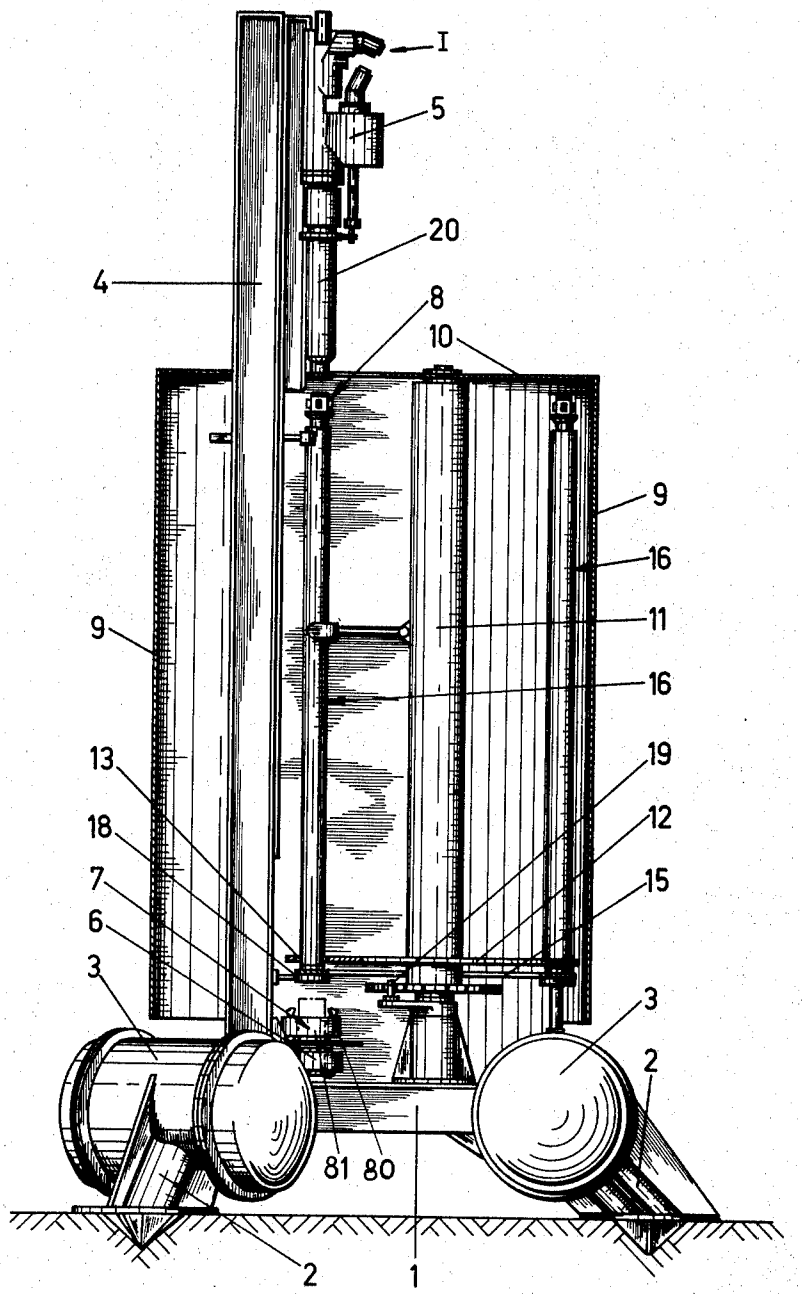


Fig_2

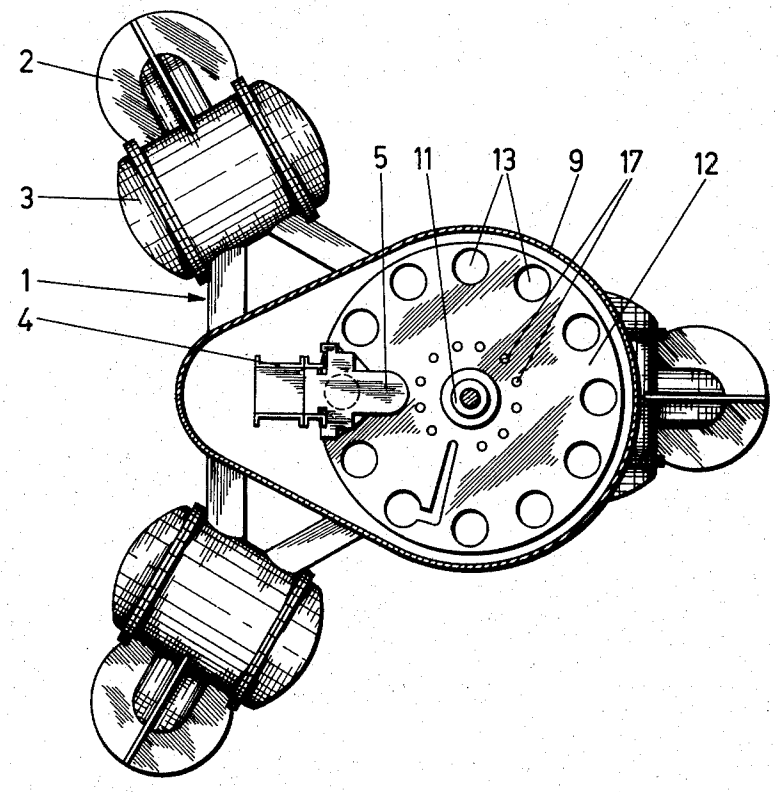


Fig. 3

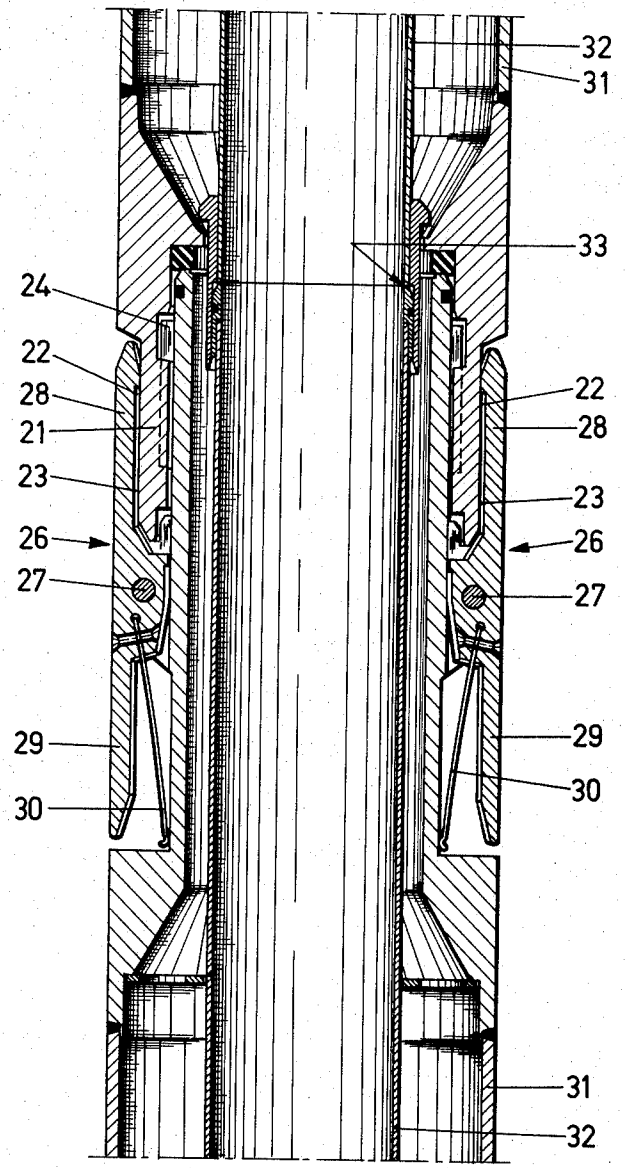


Fig-4

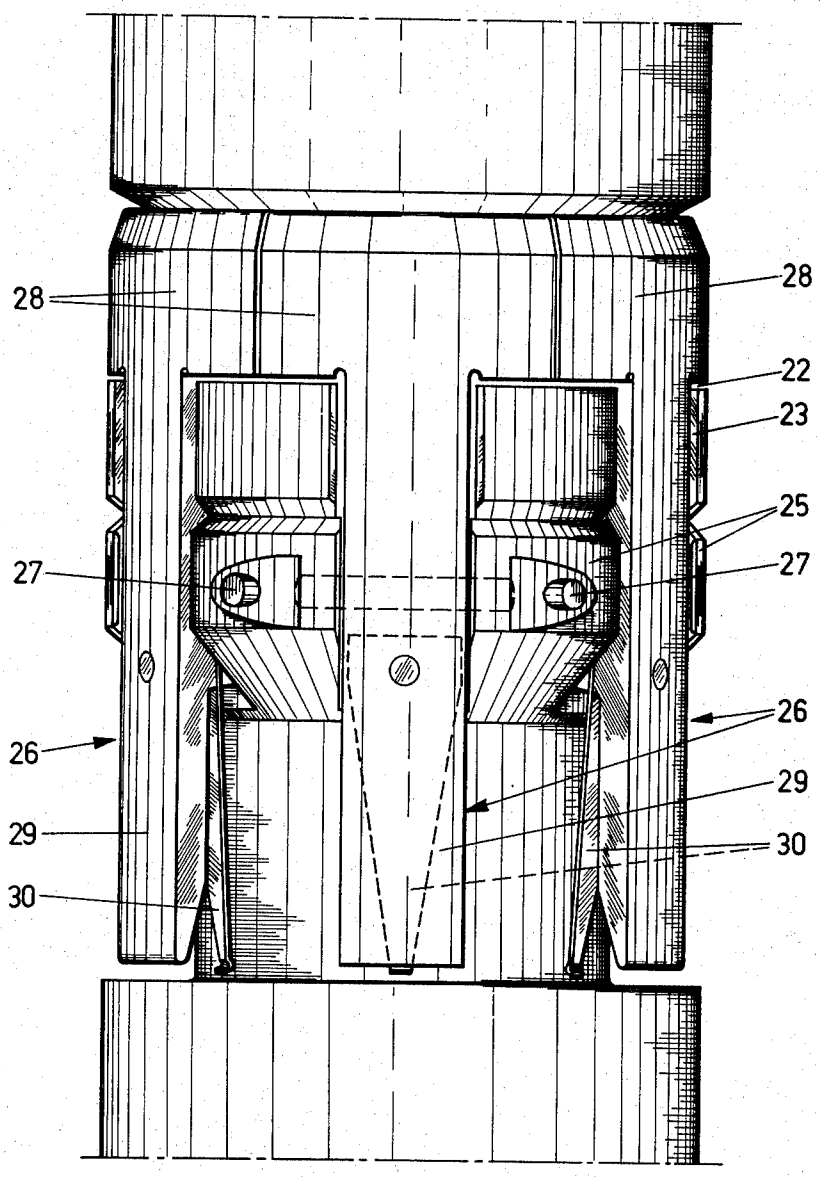


Fig. 5

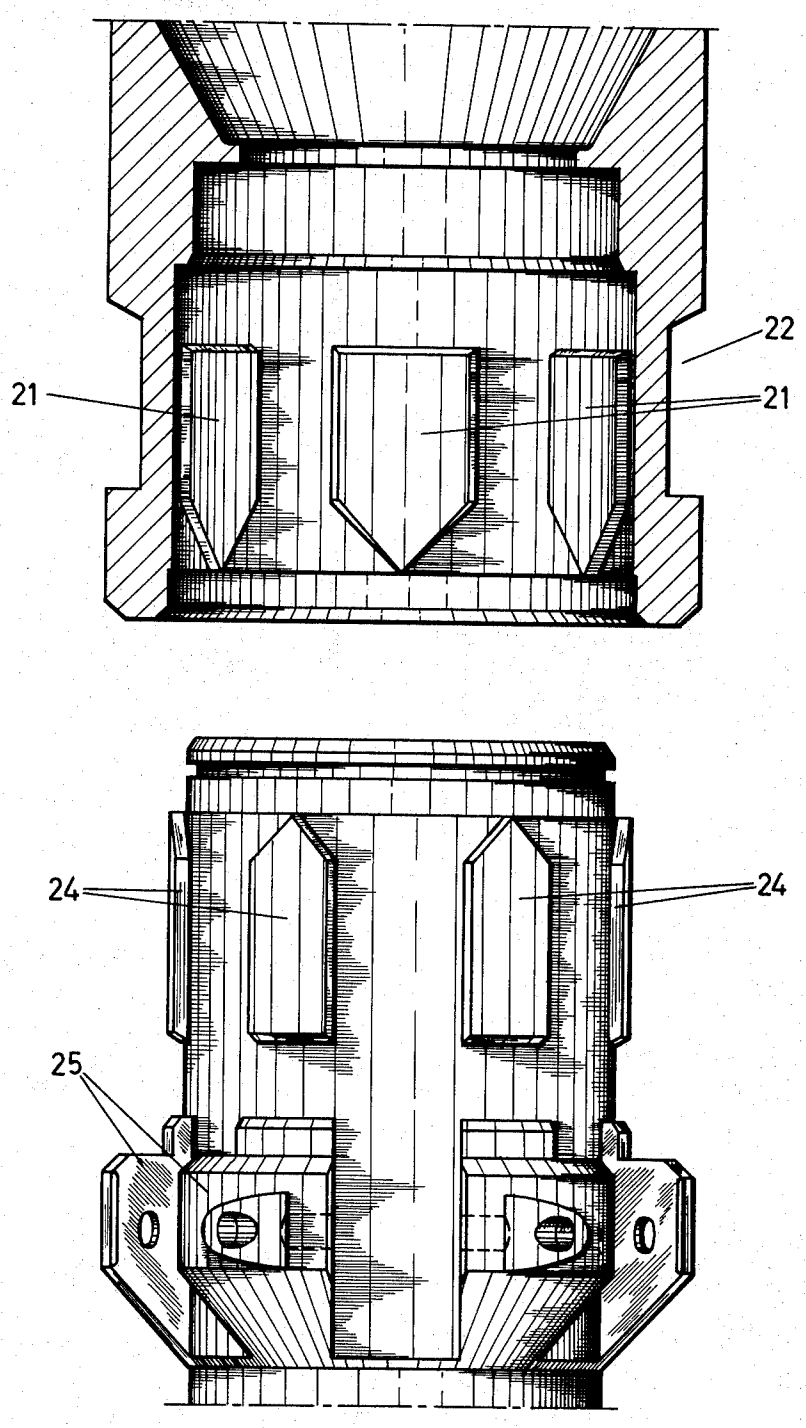


Fig - 6

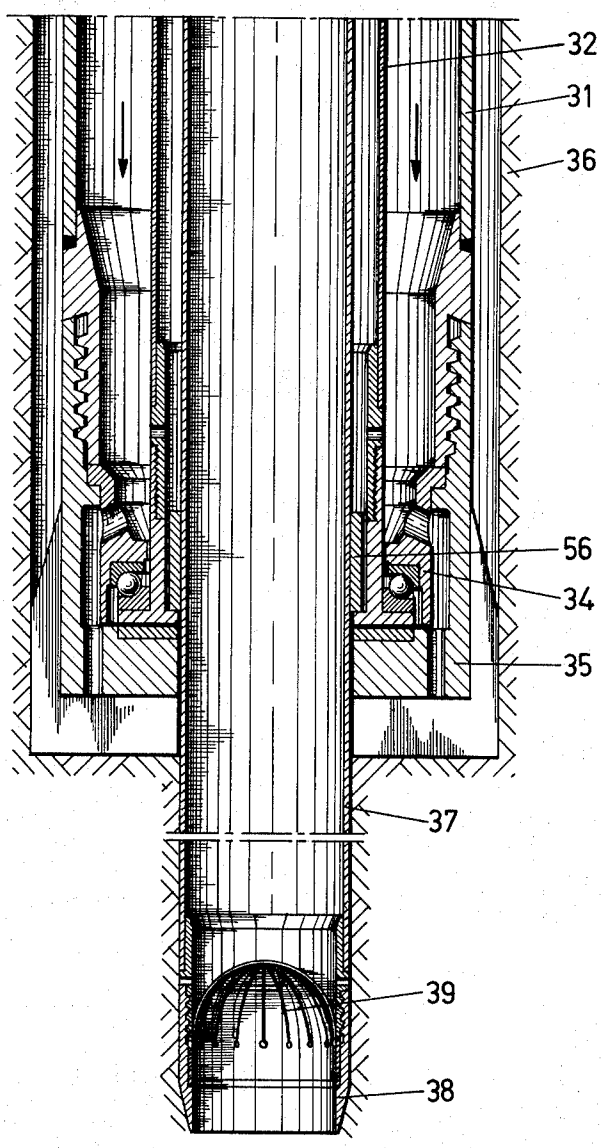


Fig. 7

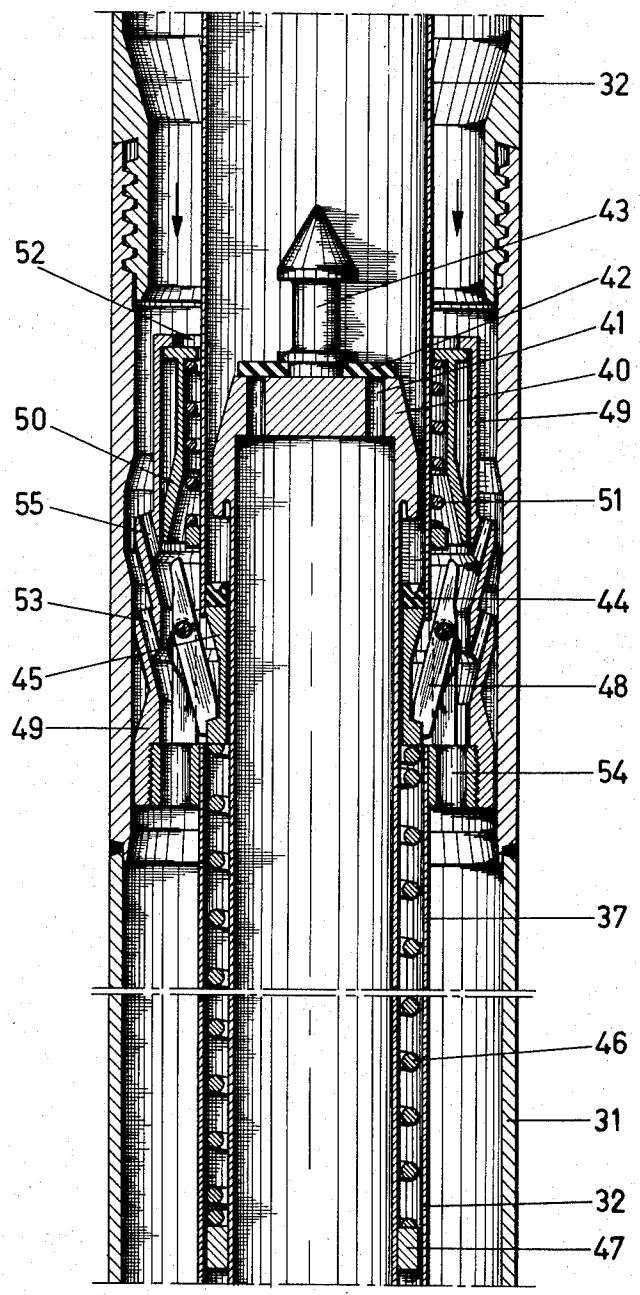


Fig - 8

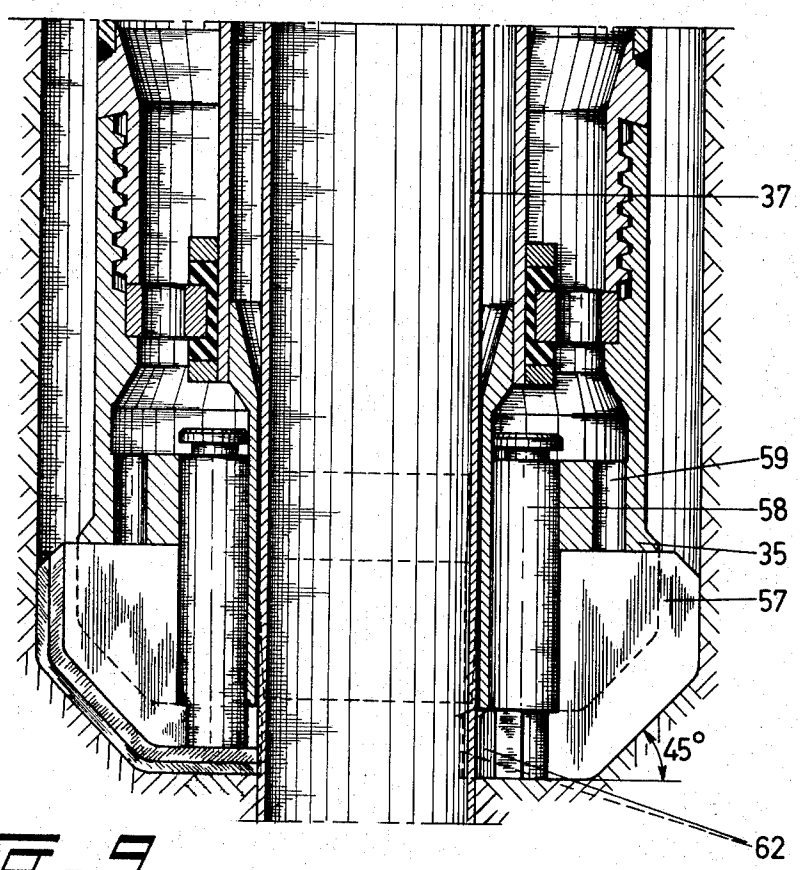
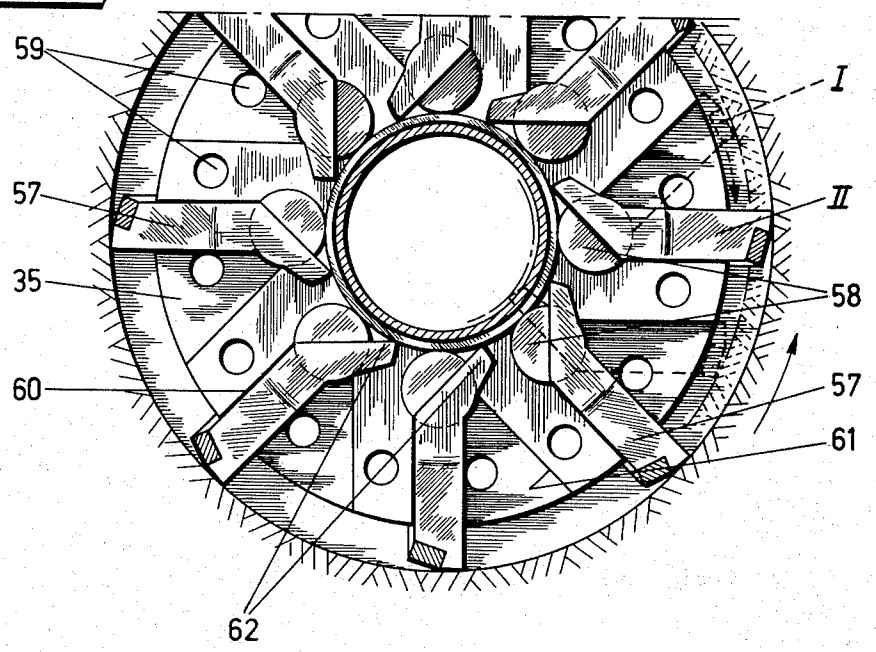


Fig - 9



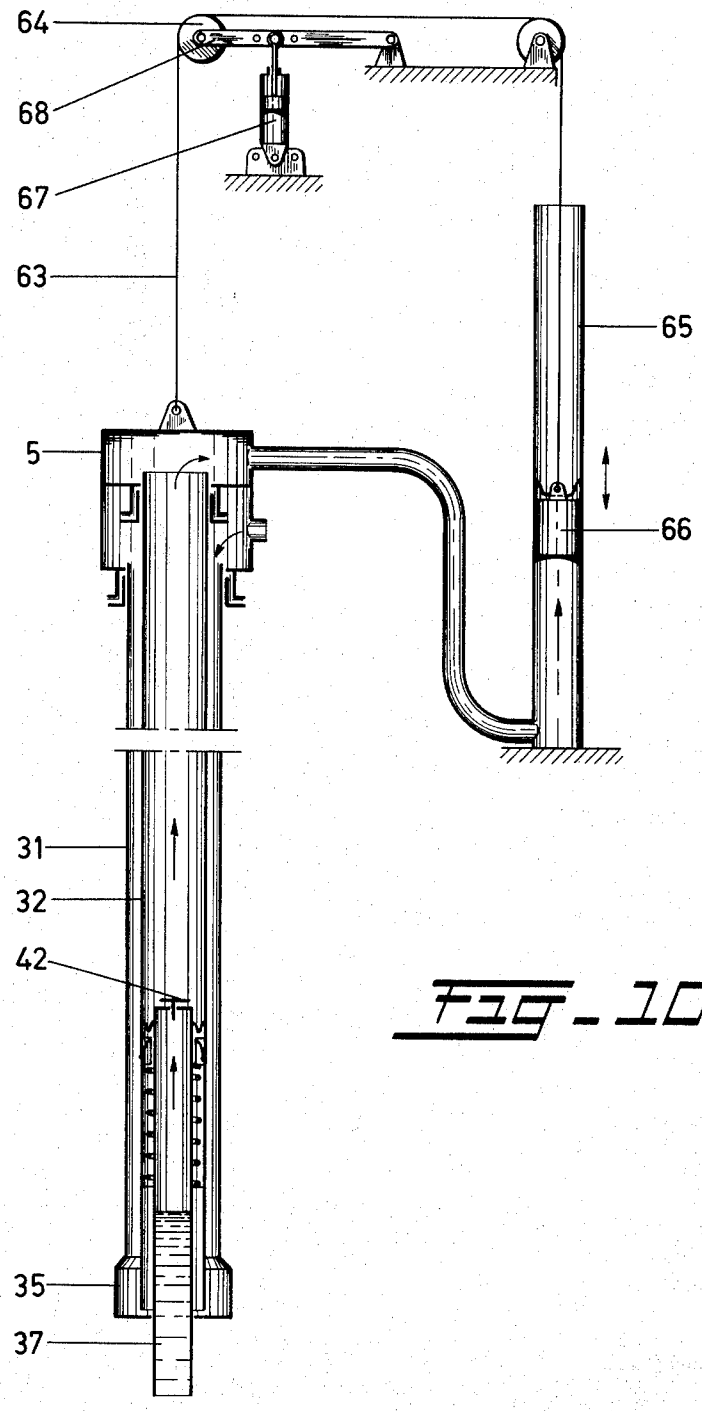


Fig_10

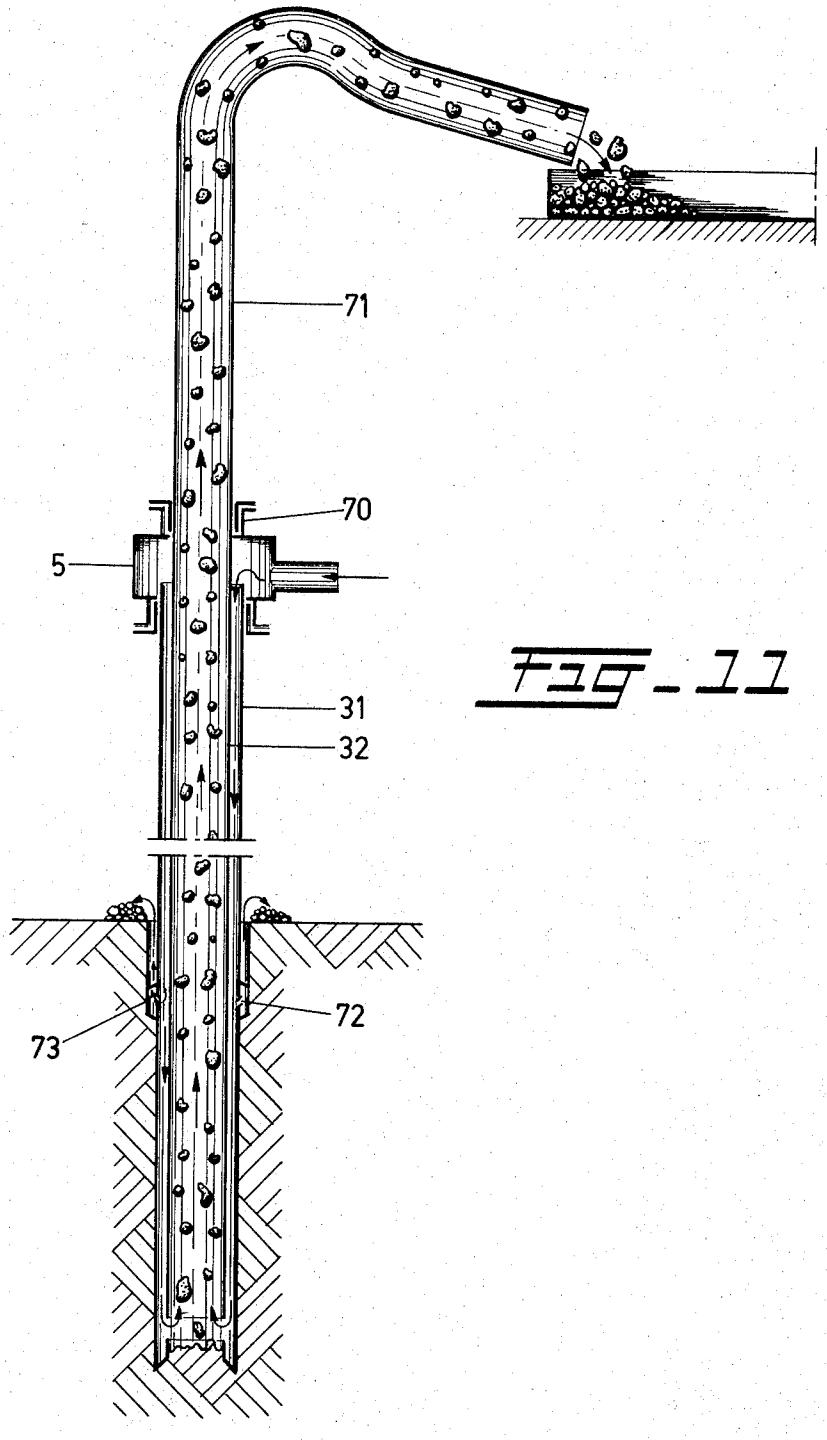


Fig - 11

DRILLING APPARATUS

BRIEF SUMMARY OF THE INVENTION

The invention relates to a drilling apparatus for obtaining a continuously cut soil sample in particular from a submerged floor. The apparatus comprises a frame and a reciprocable drilling head on the frame adapted to drive, in rotation, a drill pipe connectable to the drilling head and particularly a series of interconnected drill pipes forming a drilling string into the soil and thereafter to pull this drill pipe or drilling string out of the soil, a catch for the drill pipes being provided at the bottom of the frame. In the known drilling apparatus of this type all manipulations such as connecting and disconnecting the drill pipes from each other and from the drilling head, actuating the catch, conveying a drill pipe to extend the drilling string and replacing the drill pipes disconnected from a string while removing this string has to be done by the operators at the working location.

It is understood that the known drilling apparatus of this type are not convenient for cutting soil samples from a submerged floor.

According to the invention a drilling apparatus of this type is provided which is completely operatable by remote control so that the apparatus is adapted for being sunk, for example to the sea floor and be controlled from a vessel. To this end, the drill pipes to be combined as a drilling string are arranged on a turntable mounted in the drilling assembly in such a way that by turning this table, the pipes are placed in turn between the top part of a drill pipe already driven into the soil and the drilling head which is at its upper position. The drill pipes are provided near their upper ends with connecting means capable of cooperating with connecting means at the bottom ends of the drill pipes and at the drilling head in such a way that these two connecting means are coupled by only pushing the end parts of two pipes together or the drilling head on an end part of a pipe, said connecting means being capable of transferring torque in both directions and pull and pressure forces, while the connection can be freed by two disconnecting means operable by remote control, one near the top and one near the bottom of the drilling apparatus.

Conveniently a separate core barrel for obtaining a core can be employed, said core barrel being adapted to be resiliently locked inside the lower drill pipe in such a way that the core barrel projects beyond the drill bit at the bottom end of the lower drill pipe by a distance which depends on the type of said formation and does not rotate together with the drill pipe. To this end an inner tube is mounted inside each drill pipe in such a way that the inner tube extends in coaxial relation with the drill pipe and separates the drill pipe or the drilling string into an inner part having absolutely smooth walls formed by the interior of the inner tubes themselves and an annular outer part, between the drill pipe and the inner tube, the inner and outer parts being adapted to be connected through the drilling head with a source of a fluid while a core barrel is provided in each inner tube and the inner tube of the lowermost drill pipe is provided with catching means to catch and resiliently hold a core barrel, said catching means being adapted to be released by the flow of fluid through the outer annular part of the drilling string. The drilling head is provided with a device capable of catching the core barrel and pulling it out of the inner tube, the core barrel being capable of being raised through the inner tube by an ascending flow of fluid through the inner tube, means being provided such that each core barrel after having been pulled out can be shifted on the turntable to a position which is closer to the center of the turntable than the positions of the drill pipes in the turntable.

Preferably the connecting means for the drill pipes are formed by a series of circumferentially spaced splines near the top end of each pipe, which slidably fit between a series of corresponding splines along the outer circumference of each drill pipe near the bottom end thereof while adjacent the top end, pawls having a hammer head shaped top part are arranged which are spring biased towards the drill pipe and the bottom

end is provided with an annular recess in which the hammer heads of the pawls fit.

The disconnecting means comprises an annular clamp which can be pressed against the connecting catches.

Preferably the device for connecting a core barrel into the lower drill tube consists of a sliding bushing around each core barrel, the bushing being fixed around each core barrel by means of a seal which is provided with an annular notch around its outer circumference, a coiled spring around each core barrel positioned between the sliding bushing and an annular collar mounted around the core barrel while the inner tube of the lower most drill pipe is provided with a set of catches spring biased towards the inside of the drill tube and capable of engaging the notch of the sliding bushing with one end and extending with their other end inside the annular outer part of the drill tube, and a further sliding bushing around the inner tube which is normally positioned above the spring-loaded catches and retained in that position by said spring but which is movable downwardly by a fluid in the outer part of the drill pipe until this bushing engages the other ends of the spring-loaded catches whereby these catches are moved outwardly to a disconnecting position against the action of the spring thereof.

Conveniently the spring-loaded catches and the further sliding bushing are mounted inside a housing provided around the inner tube, said housing being provided with an orifice at its top part which is normally closed by the second bushing and at least one side orifice and a bottom orifice for passing the flow of fluid through the annular outer part of the drill pipe, while the sliding bushing is formed such that it also more or less closes the side orifices on its downward travel in order to disengage the spring loaded catches.

Conveniently the core barrel is provided with one or more orifices near its closed top part which are normally closed by a movable valve. Owing to this the fluid on top of the core can be made to perform a pulsating movement or be subjected to a sucking action.

Preferably, the turntable consists of a horizontal circular disc having evenly circumferentially spaced circular orifices with a diameter slightly larger than the diameter of the drill pipe, which disc is rotatable around a vertical axis and a fixed plate mounted at a short distance underneath this disc extending at least to the circular orifices in said disc but being interrupted in the area underneath the drilling head, while a shiftable element is adapted to occupy this interrupted portion of the fixed plate. In said disc adjacent one side of each circular orifice a tangentially extending channel is formed, which is in communication with this orifice and passes into a radially extending channel, the complete channel formed this way having a width which is slightly larger than the diameter of a core barrel.

In order to be able to drill with the drilling apparatus according to the invention through soft as well through hard formations without the necessity of changing the drilling bit, the drilling bit according to the invention is constructed in such a way that by rotating in one direction the drilling bit is adapted for drilling through a soft formation and by rotating in the other direction for drilling in a hard formation. To this end the drilling bit according to the invention is provided with a number of spaced knives which are pivotally mounted on a trunnion and formed such that by rotating in one direction the knives are automatically positioned to cover a section completely situated at the outside of the circumference of the core barrel and by rotating in the other direction to cover a section starting at the inside of the core barrel.

In order to be able to control the various operations of the apparatus, the apparatus is provided with a set of television cameras which can transfer signals towards a set of monitors placed on the vessel by which the following can be controlled: deviation of the drilling apparatus with respect to a vertical line; the position of a drill pipe or drill pipes on the turntable; the replacement of the core barrel or barrels on the turntable; the progress of the drilling head; the connecting and discon-

necting of the drill pipes; the catching of the drill pipe; the sliding downwardly of the core barrel; and the operation of the shiftable element of the turntable.

Preferably two television cameras are provided, one camera being mounted above the axis of the turntable with its lens directed downwardly, a box-like levelling instrument being mounted on the apparatus and two concentric rings around the levelling instrument being inside the field of view of the camera. The inner ring is mounted on the axis of the turntable and is provided with a number of figures corresponding with the number of drill pipes and core barrels placed on this turntable while a stationary visor is in alignment with the axis of the turntable and the center line of the drilling head. The outer ring is provided with uniformally spaced bulbs which correspond with the storing places of the core barrels. As soon as a core barrel has taken its storing place a switch is actuated by which the bulb corresponding to this place is caused to glow.

The second camera is mounted just beneath the turntable and is aimed at the lower disconnecting means and the catch while also a measuring tape travels through its field of vision, said tape being connected at its end to the top and bottom side respectively of the drilling head and guided by means of two pulleys.

The invention will now be described in more detail which referring to the drawing illustrating by way of an example an embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevational view of the drilling apparatus with the housing partly in section;

FIG. 2 is a top elevational view of the apparatus of FIG. 1;

FIG. 3 is a cross-sectional view of a part of two connected drill piles showing the connecting means of the drill pipes;

FIG. 4 shows on a larger scale and in elevational view the connecting means of two interconnected drill pipes;

FIG. 5 shows a cross-sectional view of the bottom end of one drill pipe and an elevation view of the top end of a drill pipe therebeneath the connecting means having been omitted:

FIG. 6 is a cross-sectional view of the bottom part of the lowermost drill tube having a drilling bit;

FIG. 7 is a cross-sectional view of the locking device of the lowermost drill tube, to lock the core barrel;

FIGS. 8 and 9 show the drilling bit according to the invention respectively in a partly cross sectional elevational view and a top elevational view;

FIG. 10 is a diagrammatic illustration of the apparatus according to the invention adapted for a pulsating movement; and

FIG. 11 is a diagrammatic illustration of the apparatus according to the invention adapted for counterflush operation.

DETAILED DESCRIPTION

The drilling apparatus according to the invention comprises a frame 1 having the form of an equilateral triangle and three feet 2 which are mounted pivotally and may be vertically adjustable so that the position of the apparatus can be adjusted for instance on an uneven sea floor. The feet 2 carry watertight compartments 3 for accommodating electric and hydraulic equipment. Mounted on frame 1 is an upstanding column 4 guidably supporting a reciprocable drilling head 5, a catch 6 and a disconnecting device 7 for the drill pipes. Mounted on the guiding column 4 at 8 is a second disconnecting device (not shown). The apparatus is enveloped by a casing 9 having a cover 10. On frame 1 is further mounted an axle 11 for a turntable 12. The turntable 12 consists of a circular plate in which are formed circumferentally spaced circular orifices 13 and channels 14 (for the sake of clearness only one channel 14 is shown). Drill pipes 16 project through orifices 13 and the lower ends of pipes 16 rest on a stationary head plate 15 underneath the turntable 12. The lower ends of the drill pipes slide on plate 15 upon rotation of the turntable. In the same way core barrels placed in terminals 17 of channels 14 are supported by plate 15. The area situated vertically below the head plate 15 is open and a shiftable element 18 is provided in this area. The element 18 is capable of being shifted into the outside the open area for a purpose to be explained later. The turntable is driven by a pawl and ratchet assembly 19 which rotates the turntable over a distance equal to half the pitch distance of the circular orifices. A short piece of piping 20 is mounted on the drilling head and the piece of piping 20 is provided at its bottom end with connecting means adapted to cooperate with connecting means formed at the top of each drill pipe 16 in order to connect a drill pipe with the drilling head 5. Each drill pipe 15 is provided at its lower end with a connecting means identical to the connecting means at the lower end of the piece of piping 20.

Both connecting means are shown in more detail in FIGS. 3, 4 and 5. The lower end of each drill pipe and the piece of piping 20 are provided with internal splines 21 and an annular recess 22 along its outer circumference, said outer recess 22 being in communication at the places opposite each spline 21 with recesses 23 extending axially to the end of the drill pipe. Near its top end and at the outer circumference of each drill pipe, are external splines 24 which are spaced apart so that each of splines 21 fits inside the space between each pair of splines 24. Additionally, spaced brackets 25 are mounted near the top end of each drill pipe and between the brackets 25 are locking catches 26 which are pivotally mounted on axles 27 extending between the brackets 25. Each catch 26 has a hammer head shaped top part 28 and a tail 29 which is spring-loaded by spring 30. Tail 29 has such a width that the tail fits in the axial recess 23 in the lower end of a drill pipe and the head 28 is dimensioned such that in the connecting position as shown in FIG. 4, the heads 28 of all the catches 26 substantially fill the entire annular recess 22.

In order to connect two drill pipes, their ends are simply pushed one on the other so that the internal splines 21 slide between the external splines 24, the catches 26 firstly being pushed outwardly whereafter their heads 28 enter the annular recess 22 under the action of springs 30. In order to disconnect the drill pipes, only the tails 29 of the catches 26 have to be depressed whereupon the heads 28 are lifted from the recess 22 and the pipes can be pulled apart. Thus disconnecting device 7 (FIG. 1) consists of a set of hammers 80 pivotally mounted in a ring 81 and adapted to press against the tails 29 of the catches 26.

Each drill pipe 16 consists of a pipe 31 and an inner tube 32 coaxially mounted inside the pipe and having the same length thereof, the inner tubes of all interconnected drill pipes being connected at 33 (FIG. 3) in such a way that the inner tubes have a smooth interior surface over the total length of a drilling string. In the lowermost drill pipe of the string, the inner tube 32 is mounted on bearings 34 (FIG. 6) which are provided near the lower end and the upper end (not shown) and consequently the inner tube in the lowermost drill pipe will not rotate together with this pipe. Each drill pipe and a string consisting of a number of drill pipes is thus divided into a cylindrical inner part and a separate annular outer part. Through the annular outer part a fluid is passed in the direction of the arrow in FIG. 6 for cooling a drilling bit 35 connected to the bottom end of the lowermost drill pipe and to carry away the drill cuttings or bore dust. The fluid passes through orifices formed in the drilling bit 35 and further upwardly through the space between the pipe 31 and the side walls of the drilled hole 36, (FIG. 6). Furthermore a core barrel 37 is provided for each drill pipe inside the inner part formed by the inner tube 32, the core barrel having the same length as the drill pipe. Each core barrel 37 carries a cutting shoe 38 at its lower end in which a core catcher 39 may be mounted. Each core barrel 37 has a head 40 at its top end, (FIG. 7) in which channels 41 are formed which are covered by a valve 42 on which a catch 43 is mounted. Furthermore a sealing collar 44 is provided around each core barrel, said collar being mounted on a sliding bushing 45 which is also positioned around the core barrel.

The sliding bushing 45 is displaceable together with the collar 44 over the core barrel against the action of a spring 46 which is mounted between the sliding bushing 45 and a stop ring 47 fixed to the core barrel. An annular recess is formed in sliding bushing 45 adapted to be engaged by spring-loaded catches 48 which are mounted in the inner tube of the lowermost drill pipe.

The spring-loaded catches 48 are mounted in a housing 49 provided around the inner tube 42 and are inwardly spring biased at their bottom ends. Further a second sliding bushing 50 is positioned inside housing 49, the bushing 50 being slidably mounted around the inner tube 32 while being spring biased by spring 51 against the top of housing 49, by which action the orifices 52 formed in the top of housing 49 are closed. Further side channels 55, 53 and a bottom channel 54 are formed in housing 59 to pass the flow of flushing fluid. A core barrel 37 can be freed from its connection with the drilling head by means of fluid pressure supplied to the drilling head at I (FIG. 1) in order to release the barrel and permit it to fall downwardly in the drilling string until a ring 56 on the barrel abuts against fixed structure at the lower end of the lowermost inner tube 32 as shown in FIG. 6. The sliding bushing 45 is then moved to a position in front of the spring-loaded catches 48 by fluid pressure within the inner tubes 32 to enable the catches to engage the recess of bushing 45 whereby the bushing and consequently also the core barrel 37 are locked to the inner tube and the drill pipe. When the core barrel has to be freed, the pressure of the fluid in the outer part of the drilling string is increased, by which the pressure above the orifices 52 and 53 rises automatically and the sliding bushing 50 is moved downwardly against the action of spring 51 until this bushing engages the top ends of the catches 48 and pivots these catches to positions outside the recess in sliding bushing 45 whereupon the core barrel is disengaged. By the downward movement of the bushing 50, channels 52 and 53 are also progressively closed by which the pressure in the bushing 50 increases.

FIG. 8 shows the drilling bit according to the invention which can be used to drill through soft as well as hard formations. A plurality of knives 57 (for instance eight as shown in FIG. 9) are each mounted pivotally on a trunnion 58. The configuration of the knives is such that centering of the knives is effected automatically at the transition from a soft formation to a hard formation. Flushing holes 59 are formed in the drilling bit for unhampered flushing of the drill hole. Each of the knives is provided with hard metal cutting edges in its inner and outer ends. The drilling but is rotated clockwise while drilling through soft formations and then the knives 57 bear against a supporting wall 60 (position II) and the trunnion 58 will only be lightly loaded by the extending forces.

If the drilling bit enters a hard formation this will be discerned by a decrease in progress of the drill head and an increase of the drilling force. Then the head is rotated in a counter-clockwise direction and consequently the drilling string also rotates counter-clockwise. The knives in the drilling bit will then be turned so that all knives bear against the wall 61 (position I). In this position, the cutting edge 62 will decrease the diameter of the core such that this diameter will be smaller than the inside diameter of the core barrel 37. In this case the core barrel is raised above the cutting edges 62. This can be effected by disconnecting the core barrel before changing the direction of the rotation from a clockwise to a counter-clockwise rotation and by pumping the core barrel slightly upwards to reconnect the core barrel after the direction of rotation has been changed so that the cutting edge 38 of the core barrel 37 bears against the cutting edges 62 of knives 57.

The operation of the drilling apparatus according to the invention is as follows.

The entire drilling apparatus having the first complete drill pipe, with a drilling bit, connected to the drilling head 5 and a series of identical drill pipes 16 positioned in the turntable 15 is sunk, for instance, to the sea floor. By increasing the water pressure in the inner tube 31 above the core barrel 37 the core barrel is then resiliently locked to the inner tube by means of the catches 48, after the care barrel is in its lowermost position and thus bears with ring 56 on the lower end of the lowermost inner tube 32 as shown in FIG. 6. During the rotating, drilling action of the drilling bit, the core barrel is stationary in relation to the soil. The distance by which the core barrel projects beyond the drilling bit and penetrates into the soil depends on the type of soil and the strength of spring 46 and is limited in any case by ring 56 on the core barrel, and the core barrel is freed from the bottom of the bore hole so that the water pressure in the bore hold will act against the bottom side of the core. By this it is also obtained that the flushing flow through the outer part of the drill pipe which is ejected through the channels 59 in the drilling bit enter into a space filled with fluid and not directly against the wall of the bore hole so that caving in of this space is prevented. Then the drill pipe is engaged by the catch 6 and the core barrel is disconnected and pumped upwardly by increasing the rate of the flushing flow and changing the direction of the flow of fluid in the inner part of the drill pipe so that catch 43 of the core barrel is eventually caught by the catching mechanism in the drilling head. Now the disconnecting device 7 is actuated by which the drilling head 5 is disconnected from the drill pipe and the drilling head with the depending core barrel are allowed to be raised while the turntable 12 is rotated over a distance equal to the distance between adjacent orifices 13 so that the core barrel will be moved in channel 14. When finally the drilling head has reached its uppermost position, the sliding element 18 is moved underneath the core barrel and the same is put on this sliding element after which the catch for the core barrel inside the drilling head is opened so that the core barrel can be pushed in the radial part of channel 14 to the position 17 in the turntable by a lever mechanism (not shown). Now the turntable is rotated over the same distance so that a new drill pipe will be positioned underneath the drilling head. The drilling head is then lowered until the connecting means underneath the drilling head engages the connecting means at the top end of the drill pipe and of the core barrel after which sliding element 18 is moved away. Subsequently the core barrel inside this new drill pipe is disconnected from the drilling head after which the core barrel drops inside the first drill pipe already driven into the soil and the new drill pipe is pushed onto the first drill pipe so that both drill pipes are connected to each other. Then the new core barrel is locked by means of the spring-loaded catches 48 and the drilling string so obtained is lowered to the bottom of the drill hole after which the drilling can be continued until the new drill pipe is completely rotated into the soil and the new core barrel is pressed into the soil.

The above mentioned manipulations are repeated until the drill hole has obtained its desired depth or all drill pipes on the turntable have been used. After the last core barrel has been placed in the turntable by the aforementioned operation, the drill pipes are pulled out one by one by the drilling head and put on the turntable and finally the whole drilling apparatus is hoisted on board the vessel. Now the cores can be withdrawn from the core barrels and subsequently the empty core barrels replaced in the drill pipes after which the drilling apparatus is ready for the next drilling operation.

In FIG. 10 a modification of the apparatus according to the invention is shown, in which the fluid head above the core inside the core barrel can be made to effect a pulsating movement, by which the core inside the core barrel is drawn upwardly and a better core recovery obtained. To this end, a steel cable 63 is attached to the drill head 5 and passed over the pulleys 64 to the open cylinder 65. Inside cylinder 65 is a piston 66 which is capable of performing reciprocating movement by means of a hydraulic cylinder 67. The pulsating rate and the piston stroke are adjustable. The fluid inside the inner tube is caused to move while during the upwardly directed stroke, the fluid on top of the core is progressively withdrawn through the valve 42 by which action the core will be drawn upwardly and intact.

In FIG. 11 another modification of the apparatus according to the invention is shown, which is adapted for counterflush operation. Namely, the core which is cut loose is moved continuously upwardly through the drill pipe whereby no core barrel is employed. This operation is particularly applicable in sampling alluvial ore deposits, for estimating the ore content.

In this arrangement, the drill head is provided with sealing means 70 at its top, through which the inner tube 32 extends. A flexible hose 71 is attached to the inner tube 32, so that the material which is cut loose by the drill but can be carried continuously upwardly through the tube 32 and the hose 71 towards a surface vessel.

In order to reduce the friction between the outer wall 31 of the drill pipe and the wall of the drill hose, cutting edges 72 may be provided on the drill pipe at a predetermined distance from the drill bit. The drilled solids produced by the cutting edges 72 are carried up by a small part of the fluid which passes through the small orifices 73 formed in the drill pipe 31.

The drilling apparatus according to the invention is thus operable by remote control. A multicore cable provides for the supply of energy, the commands and the returning signals.

Also provisions are made to be able to disconnect the connection of the drill pipe to the drilling head in case of emergencies, so that the complete drilling apparatus will not become lost. The drilling string can then be removed by pulling directly with a hoist on the vessel.

What is claimed is:

1. Drilling apparatus for obtaining a continuous soil sample, said apparatus comprising a drill head, means for connecting drill pipes in succession to said head to form a string, and means for controlling connection of said pipes one to another from a location remote from said drilling head, each drill pipe having top and bottom ends with connecting means, said drill head also including connecting means, the connecting means at the top of each drill pipe being engageable with the connecting means at the lower end of another drill pipe or with the connecting means of the drill head by relative axial engaging movement, said connecting means being capable of transferring torque in both directions and axial and pressure forces, and disconnecting means operable by remote control for releasing the connecting means between the pipes and the head, said connecting means for the drill pipes comprising a series of circumferentially spaced splines near the top and bottom ends of each pipe, said splines slidably interfitting with one another when the pipes are connected by relative axial movement, spring-loaded locking catches pivotably mounted on each pipe, said catches each including a hammer head shaped top part urged towards the drill pipe, said pipes each having an annular recess for receiving the hammer head parts of the locking catches.

2. Apparatus as claimed in claim 1 wherein said means for controlling connection of said pipes comprises controlled fluid means.

3. Apparatus as claimed in claim 1 wherein said disconnecting means comprises an annular member including means for acting on said locking catches to pivot the hammer head parts thereof from said recess.

4. Apparatus as claimed in claim 1 comprising a drilling bit coupled to the lowermost pipe of the string, said bit being constructed in such a way that by rotating in one direction the drilling bit is adapted for drilling through a soft ground formation and by rotating in the other direction for drilling in a hard ground formation.

5. Apparatus as claimed in claim 4 wherein the drilling bit includes a plurality of spaced knives which are pivotally mounted and formed such that by rotating in one direction the knives are automatically positioned to cover a section completely situated at the outside of the circumference of a core barrel and by rotating in the other direction to cover a section starting at the inside of the core barrel.

7. Apparatus as claimed in claim 1 comprising a turntable storing the drill pipes such that by turning the table the drill pipes are successively positioned between the drilling head and the top of the uppermost drill pipe extending into the soil.

7. Apparatus as claimed in claim 6 wherein the turntable comprises a horizontal circular disc having circumferentially and uniformly spaced circular orifices with a diameter slightly larger than the diameter of the drill pipe, said disc being rotatably mounted around a vertical axis and a fixed plate mounted at a short distance underneath this disc extending at least to the circular orifices in said disc but being interrupted in the area underneath the drilling head and a shiftable element adapted to occupy this interrupted portion of the fixed plate.

8. Apparatus as claimed in claim 7 wherein said disc has a tangentially extending channel opening into each circular orifice, and a radially extending channel opening into each tangentially extending channel, said channels have a width which is slightly larger than the diameter of a core barrel.

9. Apparatus as claimed in claim 6 comprising a separate core barrel detachably connected inside each drill pipe such that upon increase of fluid pressure the core barrel is released.

10. Apparatus as claimed in claim 9 comprising means for resiliently locking each core barrel inside the lowermost drill pipe of a drilling string, such that the core barrel projects beyond a drill bit at the bottom end of the lowermost drill pipe by a distance which depends on the ground formation from which a core sample is to be obtained.

11. Apparatus as claimed in claim 10 wherein the core barrel is provided with at least one orifice near the closed top part thereof and a movable valve normally closing said orifice, and means for acting on fluid through said valve and in said core barrel to facilitate withdrawal of a core to a position within the barrel.

12. Apparatus as claimed in claim 11 wherein said means which acts on said fluid comprises means for pulsating the fluid.

13. Apparatus as claimed in claim 12 wherein said means which acts on said fluid comprises means for subjecting the fluid to suction.

14. Apparatus as claimed in claim 9 comprising an inner tube coaxially mounted inside each drill pipe to form a continuous inner space through the length of the drilling string, and an annular outer space between the inner tubes and the drill pipes.

15. Apparatus as claimed in claim 14 wherein the core barrel is located in the inner tube, the inner tube of the lowermost drill pipe including latching means to catch and resiliently hold a core barrel, said latching means being adapted to be released by the pressure of fluid in the outer annular space of the drilling string.

16. Apparatus as claimed in claim 15 wherein the drilling head is provided with a device capable of catching the core barrel to pull it from the inner tube, the core barrel being raised through the inner tube by an ascending flow of fluid through the inner tube.

17. Apparatus as claimed in claim 16 comprising means for shifting each core barrel after being pulled out on the turntable to a position which is closer to the center of the turntable than the positions of the drill pipes in the turntable.

18. Apparatus as claimed in claim 15 wherein said latching means comprises a sliding bushing on each core barrel, a sealing member carried by said bushing to provide a seal between the core barrel and the surrounding inner tube of the lowermost drill pipe, an annular stop ring on the core barrel, a coil spring around each core barrel positioned between the sliding bushing and said annular stop ring, a plurality of catches on said drill pipe spring biased towards the inside of the drill tube and including one end for engaging the sliding bushing and an opposite end and extending inside said annular outer space of the drill tube, and a further sliding bushing on the inner tube normally positioned above the spring-loaded catches and movable downwardly by pressure fluid in the outer part of the drill pipe until the further bushing engages said opposite ends of the spring-loaded catches to move these catches outwardly to a disconnecting position.

19. Apparatus as claimed in claim 18 wherein said latching means further comprises a housing around the inner tube of the lowermost pipe receiving the spring-loaded catches and the further sliding bushing, said housing being provided with an orifice at the top thereof, which is normally closed by the further bushing and at least one side orifice and a bottom orifice for the flow of fluid through the annular outer space of the drill pipe, said further bushing being shaped such that it closes, at least partially, the side orifices upon its downward travel when it disengages the spring-loaded catches.

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