United States Patent [19]

Hilfing

[11] **3,741,320**

[45] **June 26, 1973**

[54] **SUBSEA DRILLING ASSEMBLY**

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[52] **U.S. Cl.** **175/6,** 175/45, 175/85, 175/52

[51] **Int. Cl.** **E21b 19/14,** E21b 47/02

[58] **Field of Search** E21c/19/00; 175/5, 175/6, 8, 52

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Primary Examiner—Joseph H. McGlynn
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[57] **ABSTRACT**

An off-shore drilling assembly comprises a main body which has sheaves or pulleys so that it can be lowered from a vessel like a block.

The main body performs a core drilling operation resting on the seabed. A traveller body can be pulled up and down between the vessel and the main body, fetching a core-containing core barrel inner tube from the bore-hole and delivering it to the vessel and returning it the emptied core barrel inner tube to the core barrel outer tube at the bottom of the bore-hole. The traveller body is firmly attached to the main body when it lands thereon.

19 Claims, 25 Drawing Figures

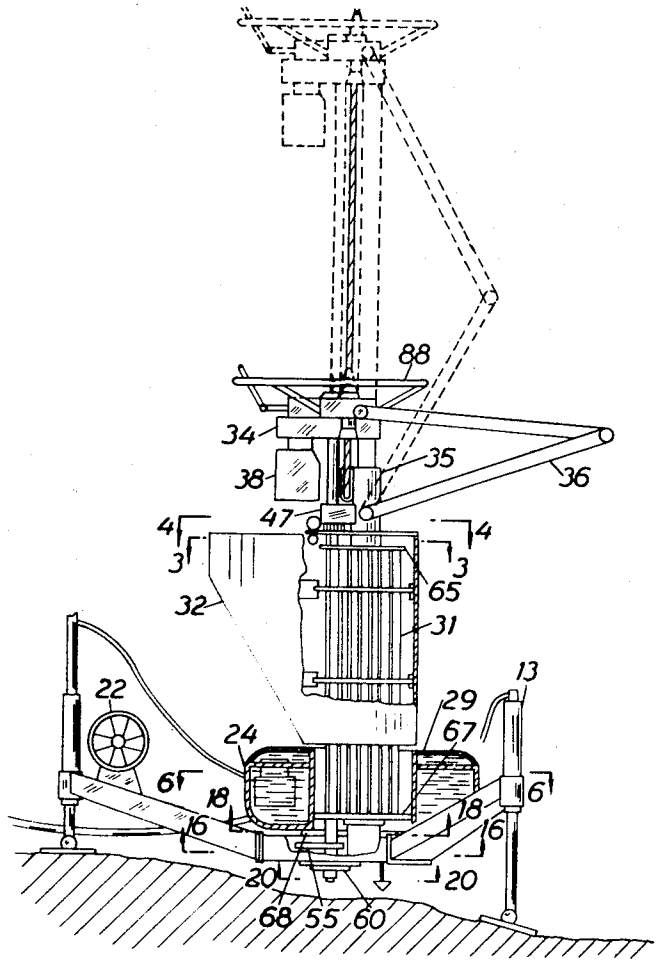
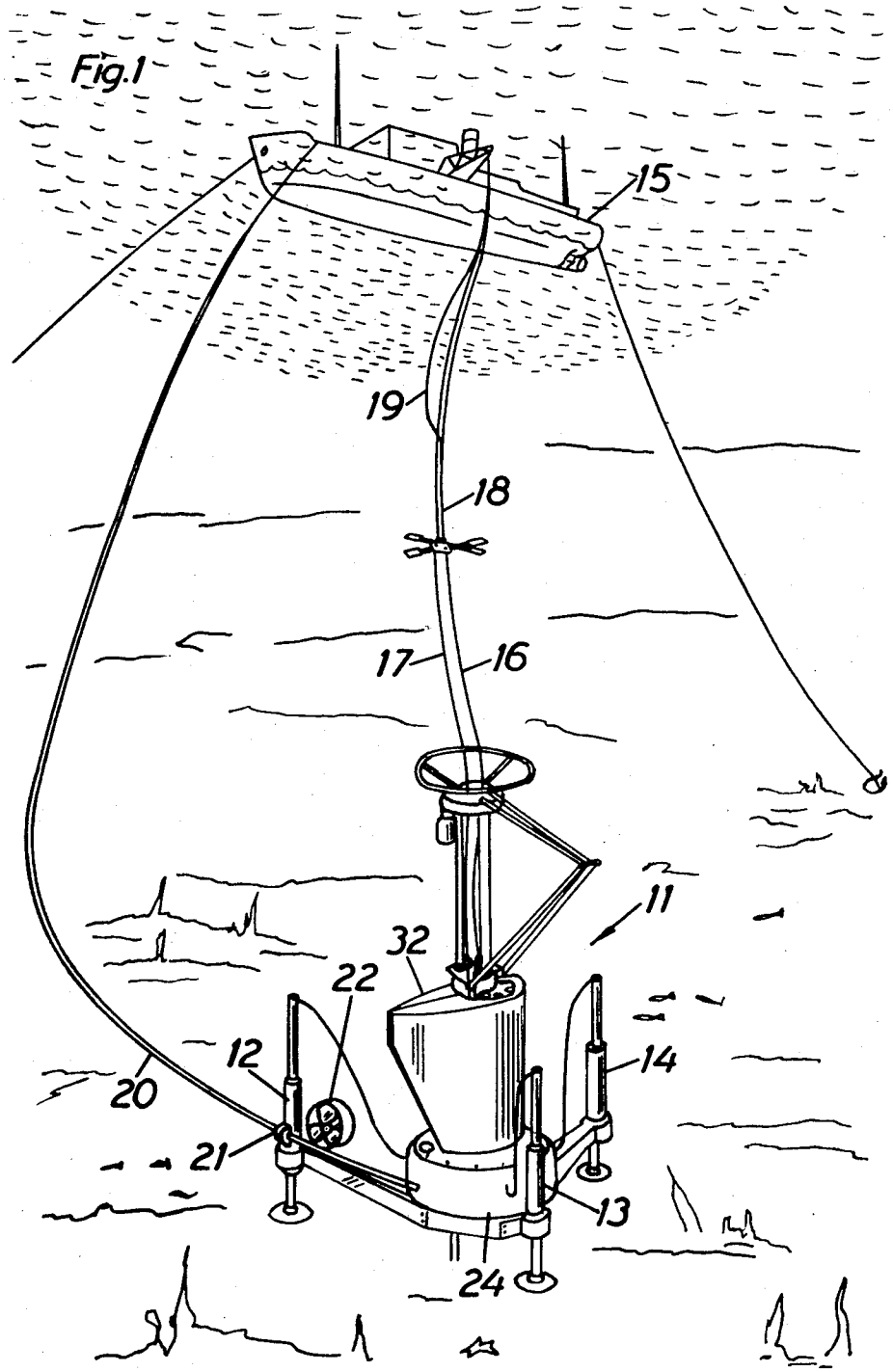


Fig.1



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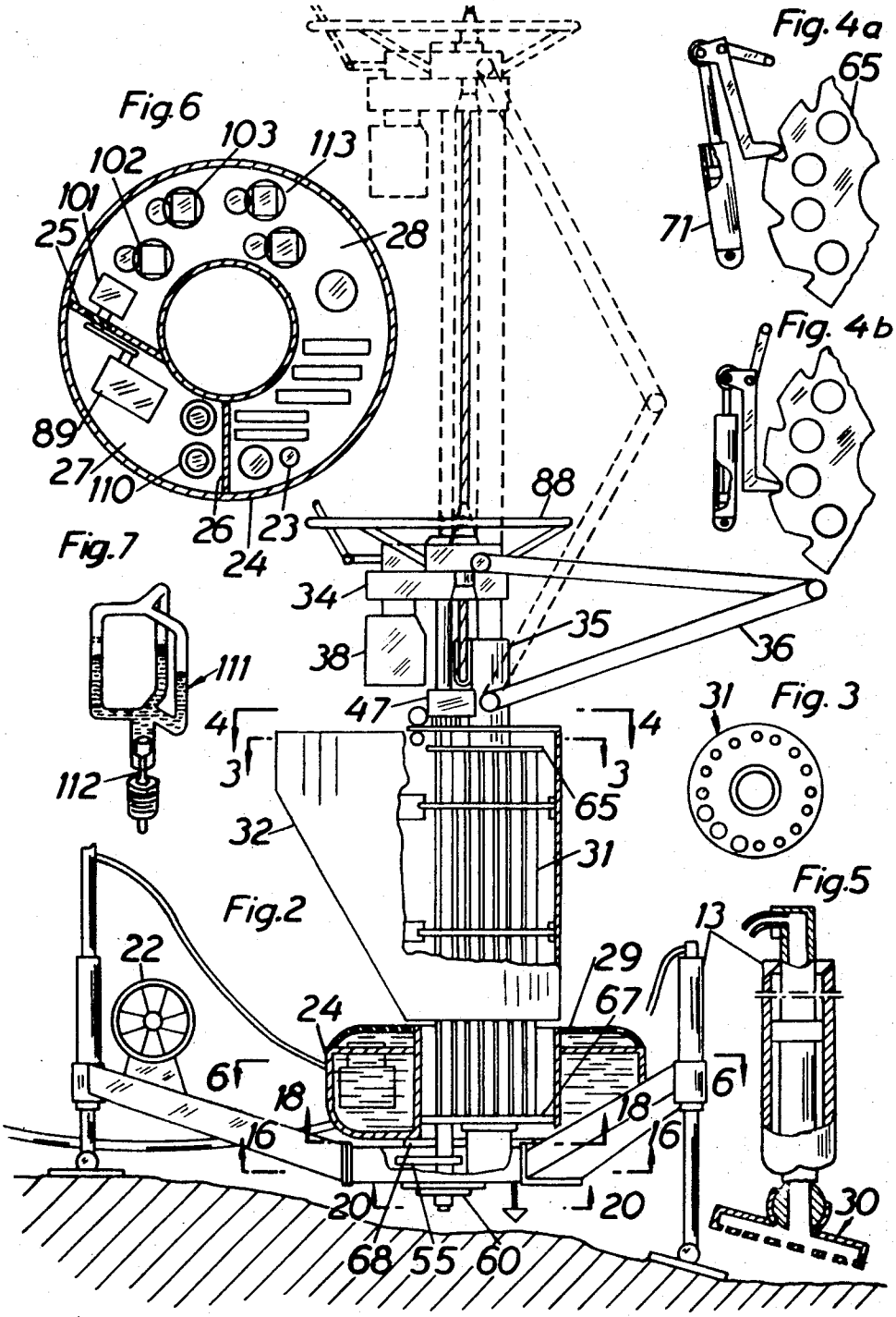

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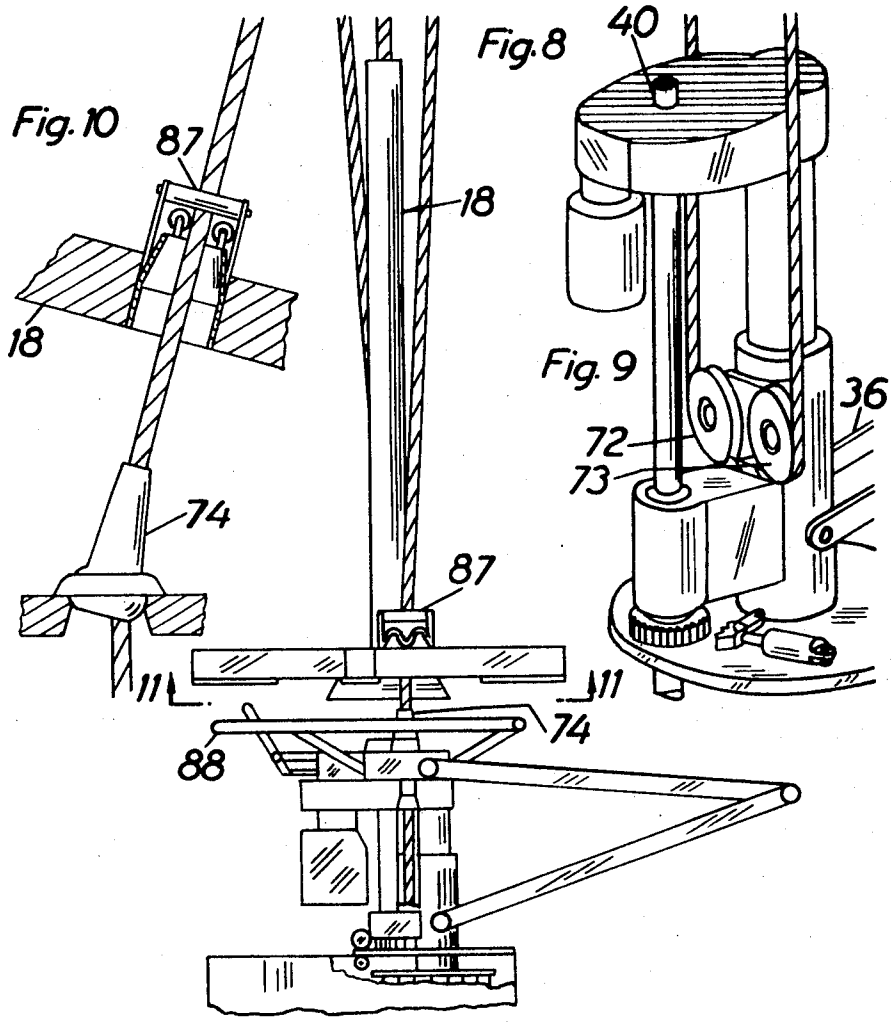

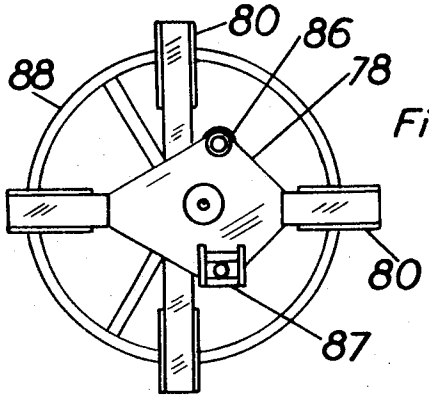

Fig. 11

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Fig. 12

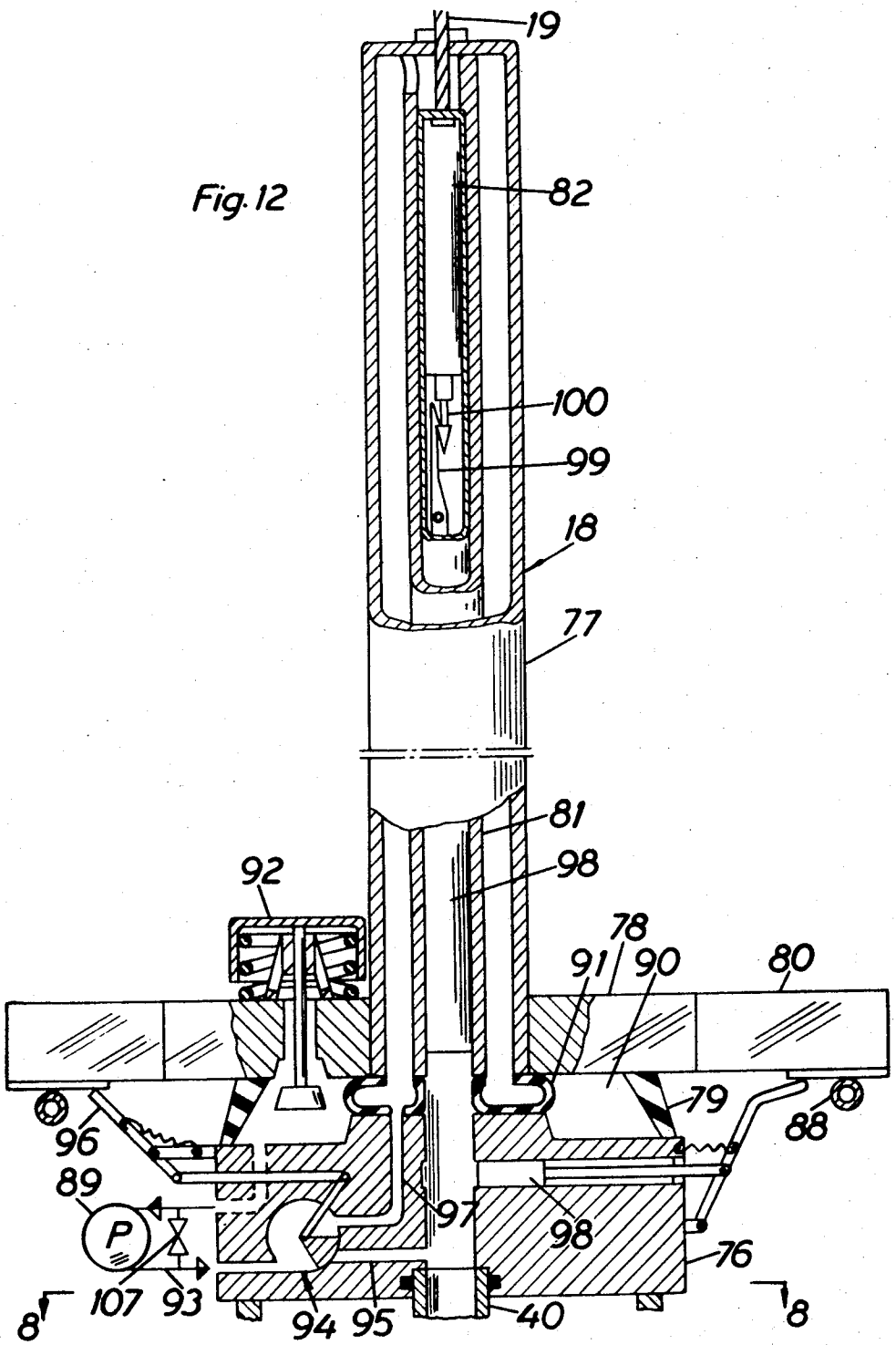

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Fig. 13

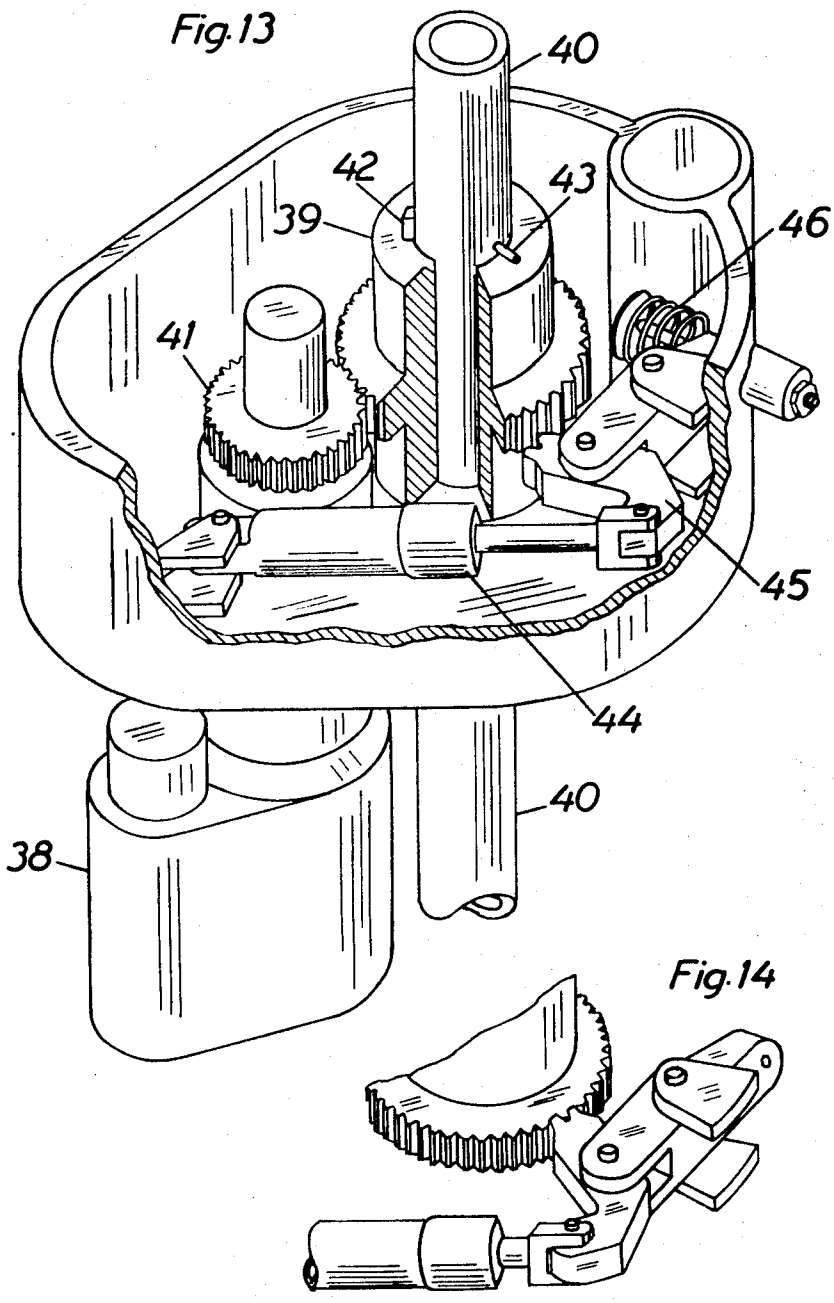

Fig. 14

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Fig. 15

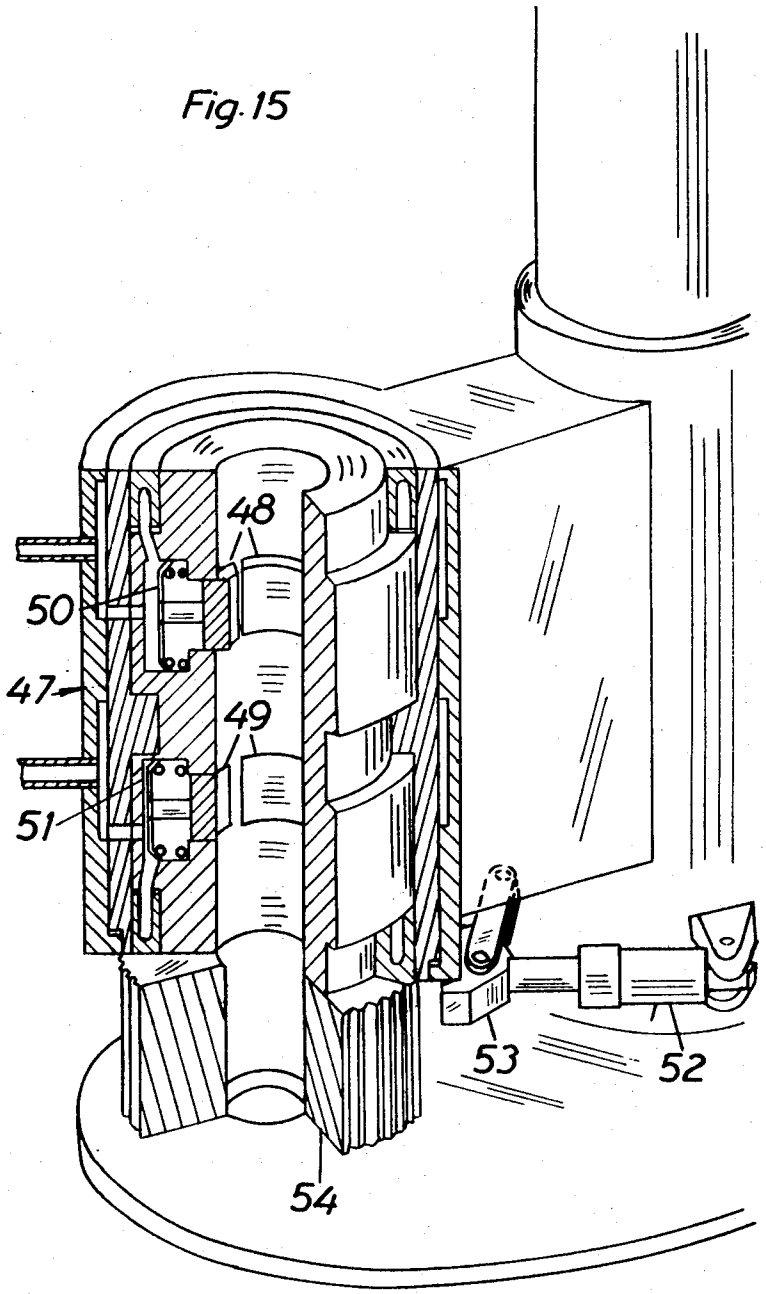

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Fig. 16

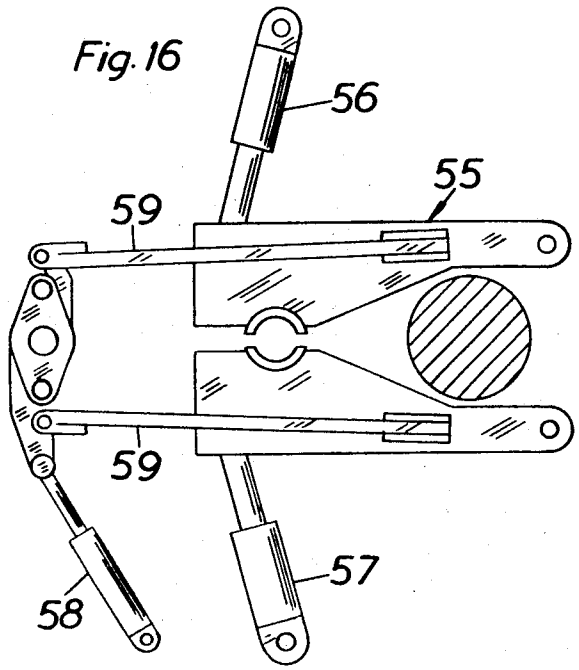

Fig. 17

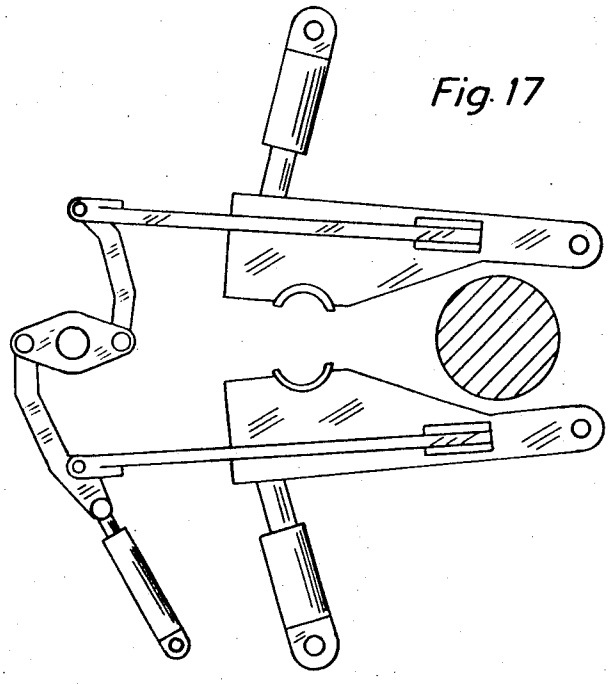

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Fig. 18

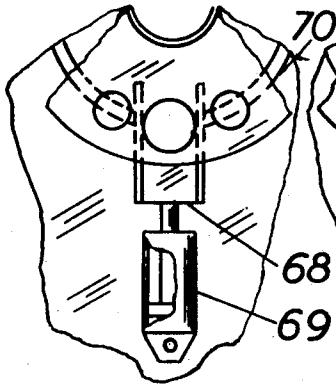

Fig. 19

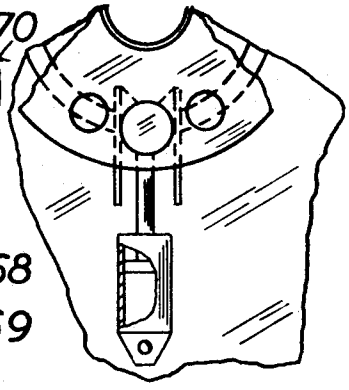

Fig. 21

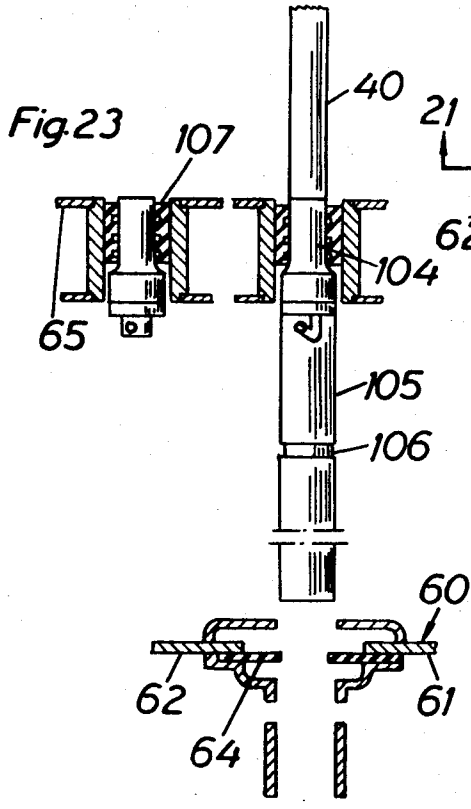

Fig. 20

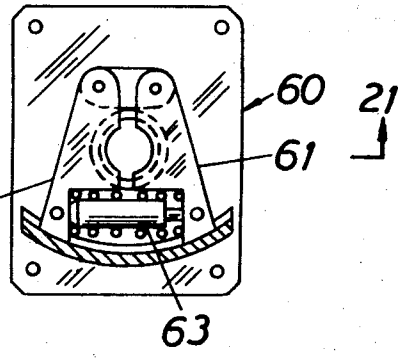

Fig. 22

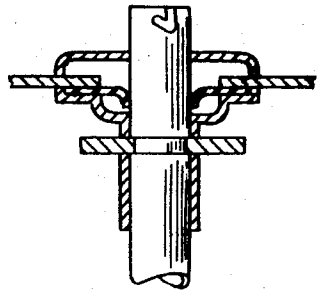

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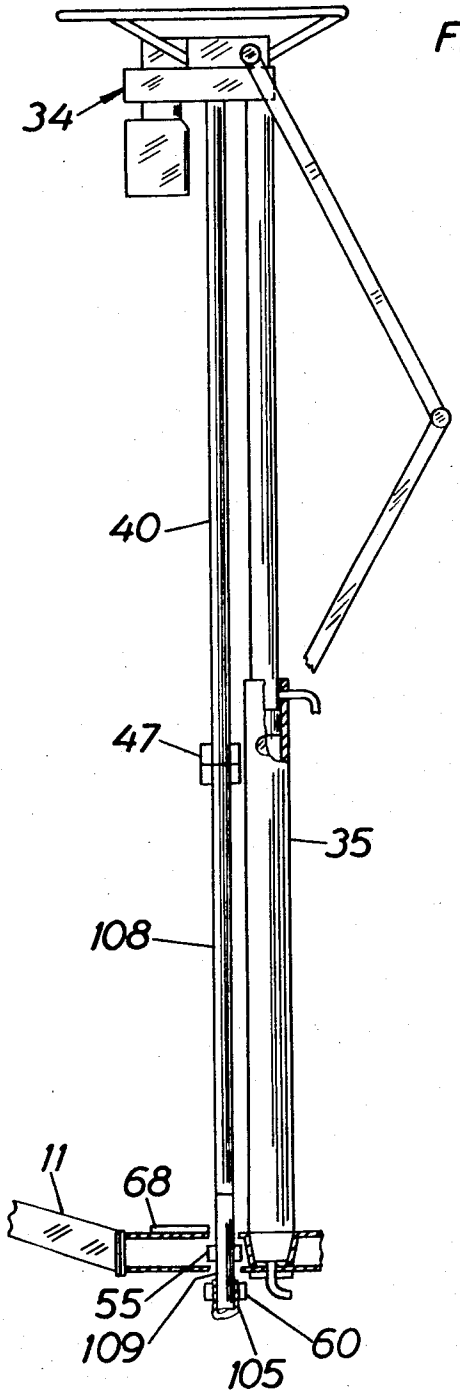
Fig. 24



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SUBSEA DRILLING ASSEMBLY

This invention relates to an off-shore drilling assembly of the kind which has a main body arranged to be lowered from a vessel or another floating structure and which, resting on the seabed, is arranged to perform a core drilling operation which includes successive addition of string elements to the drill string. Such drilling assemblies are very suitable for surveying purposes and especially for surveying and prospecting the continental shelf.

It is an object of the invention to provide a drilling assembly of the kind referred to in which the core formed during the drilling is brought up to the surface before drilling continues after each addition of a drill string element to the drill string. Other objects will be apparent from the detailed description and claims.

In the drawings:

FIG. 1 is a perspective view of a drilling assembly located for off-shore drilling.

FIG. 2 is a side elevational view of a body shown in FIG. 1 and standing on the sea-bed.

FIG. 3 is a fragmentary section on line 3—3 in FIG. 2.

FIG. 4*a* is an enlarged fragmentary section on line 4—4 in FIG. 2.

FIG. 4*b* is the same section as FIG. 4*a* but showing some details in another position.

FIG. 6 is a fragmentary section on line 6—6 in FIG. 2.

FIG. 7 shows a detail indicated in FIG. 6.

FIG. 8 is an elevational view like FIG. 2 but showing only the upper portion of the body, a traveller body being also shown.

FIG. 9 is a perspective view showing the upper portions of the body shown in FIG. 2, the uppermost portion, however, being cut away.

FIG. 10 shows some details shown in FIG. 8.

FIG. 11 is a view on line 11—11 in FIG. 8.

FIG. 12 is a section through a traveller body shown in FIGS. 8 and 11 and the upper portion of the body shown in FIG. 2.

FIG. 13 is a perspective view of a rotation unit (drill) located at the upper portion of the body in FIG. 2.

FIG. 14 shows some details of FIG. 13 in another position.

FIG. 15 is a perspective view partly in section of a chuck unit which is part of the body shown in FIG. 2.

FIG. 16 is a fragmentary section taken along the line 16—16 in FIG. 2 drawn to an enlarged scale and showing a clamp.

FIG. 17 is the same section as FIG. 16 but the details are shown in another position.

FIG. 18 is a fragmentary section taken along the line 18—18 in FIG. 2, showing drawn to an enlarged scale a shutter.

FIG. 19 is the same section as FIG. 18 but some details are shown in another position.

FIG. 20 is a fragmentary view taken along the line 20—20 in FIG. 2, drawn to an enlarged scale showing a casing tube clamp.

FIG. 21 is a fragmentary section taken along the line 21—21 in FIG. 20.

FIG. 22, , is another fragmentary section along line 21—21 in FIG. 20.

FIG. 23 shows a detail of FIG. 21.

FIG. 24 is a diagrammatic, fragmentary version of FIG. 2.

FIG. 5 is an enlarged section through a leg of the body shown in FIG. 2.

In FIG. 1 there is shown a main body 11 having a tripod frame with legs 12–14 which supports it on the sea bottom. The main body 11 has been lowered from a ship 15 and is suspended by two lines 16,17 which form a single line which engage sheaves or pulleys on the main body; and a traveller body 18, suspended by another line 19, is shown on its way between the ship and the main body along the lines 16,17. An electric cable 20 contains electric power lines for supplying the main body with electric power, and it contains also a large number of electric check lines and control lines so that the drilling operation can be completely controlled from the ship.

The electric cable is attached at 21 to the leg 12 and since the line 16,17 and the cable 20 are spaced apart where they are connected to the ship, this arrangement will prevent the main body 11 from rotating when being lowered from the ship. However, this arrangement is sometimes not sufficient when the main body 11 is to be lowered to deeper areas and a propeller 22 driven by a reversible hydraulic motor is therefore utilized for stabilizing the main body during the lowering. The main body is preferably provided with a direction sensing means such as a gyroscope or a compass indicated by 23 in FIG. 6 and the direction is indicated on board the ship from where the rotation of the propeller 22 is controlled.

The triod main body has an annular housing 24 which has two partitions 25,26 (FIG. 6). These partitions divide the housing in a chamber 27 which is open to the surrounding water and a watertight chamber 28 which is filled with oil and has an elastomeric cover 29. Because of the flexible cover 29, there will always be the same pressure in the oil inside the chamber 28 as in the surrounding water and the walls of the housing 24 can therefore be thin.

The legs 12–14 consist of double acting hydraulic jacks with shoes 30 universally mounted on the pistons of the jacks (FIG. 4*b*). The bottoms of the shoes have holes through which water can be pumped out so as to facilitate the lifting of the main body if the legs have sunk into the sea-bottom. The pressure in the pressure chambers of the jacks, that is, the load on the legs are sensed and transmitted electrically to the ship so that the risk of tilting of the main body is on a receiver indicated on board the ship. A circular revolving magazine 31 for drill rods (drill pipe lengths) extends into the central opening of the annular housing 24 and it is surrounded by a streamlined casing 32 which is freely rotatable and has the only functions of reducing the dynamic forces on the main body.

A drill unit 34 is reciprocable by means of a double-acting hydraulic feed jack 35 which is mounted in the tripod main frame. Articulated struts 36 are arranged to take up the reaction forces from the rotation and transmit the forces to the feed jack 35. The drill unit 34 is shown in detail in FIG. 13 and it has a double-acting hydraulic rotation motor 38 which, preferably, is a positive displacement motor e.g., an axial piston pump. The motor rotates a geared bushing 39 for a drive rod 40 by means of a drive gear 41. The bushing 39 and the drive rod 40 rotate conjointly because of a key 42, and axial forces are transmitted between the bushing 39 and the drive rod 40 by means of radial pins 43 which are strong enough to resist the axial forces during oper-

ation but which will break if the drill string by some reason becomes stuck so that the main body has to be brought up to the surface leaving the drill pipe (the drill string) in the bore hole. In this case the drive rod **40** will remain on top of the drill string.

A hydraulic jack **44** is coupled to a member **45** which has two teeth which are free from engagement with the teeth of the bushing **39** when the jack is in its extended position as shown in FIG. **13.** When the jack is being retracted, however, the toothed member **45** moves into engagement with the bushing **39** as shown in FIG. **14** and since the jack **44** and the rotation motor **38** can be operated simultaneously, the torque will be great enough to ensure breaking of a screw-joint between two drill string lengths or the screw joint between the drive rod **40** and the drill string. A coil spring **46** is provided so as to yield if the teeth of the member **45** should face two teeth on the bushing gear.

A freely rotating double chuck unit **47** is mounted on the feed jack **35** just above the magazine **31** and the casing **32,** and it is shown in perspective in FIG. **15** drawn to an enlarged scale. It has two independently actuated chucks, each having three jaws **48,49** carried by hydraulically actuated pistons **50,51.** The chuck unit **47** can be locked against rotation by means of a hydraulic jack **52** which has a toothed member **53** for engaging a toothed ring **54** of the chuck unit. Below the annular housing **24** inside the tripod frame, there is another chuck or clamp **55** (FIG. **16**) for holding the drill pipe. The clamp **55** is actuated by means of two hydraulic jacks **56,57,** and it can be opened wide by means of a third jack **58** so as to allow insertion of a casing pipe as will be described. Heavy springs **59** will ensure the holding of the drill pipe even if the jacks **56,57** should fail. Below the clamp **55** there is a casing clamp **60** (FIG. **20**) with dogs **61,62** which are opened by spring bias and actuated to grip by means of a hydraulic pull jack **63.** A rubber plate **64** is arranged so as to prevent mud and sand from flowing directly into the clamps **60,55.** The revolving magazine **31** is carried by the feed jack **35** which it surrounds and it comprises an upper transverse plate **65** and a lower transverse plate **67** which are interconnected. A shutter **68** actuated by a hydraulic jack **69** is arranged under the lower plate **67** of the magazine and in FIG. **18** it is shown open and in FIG. **19** closed. The shutter **68** moves into an opening in a stationary annular plate **70** which forms an abutment for a number of drill pipe lengths, the core barrel, and two casing tubes which all are inserted through holes in the transverse plates **65,67** of the magazine. The magazine **31** can be rotated stepwise by means of a hydraulic jack **71** as can be seen from FIGS. **4***a* and **4***b*.

The two guide lines **16,17** are shown as a single line which pass over two sheaves or pulleys **72,73** and two guide members **74** which are mounted on the drill unit **34** for guiding the line **16,17** and also for guiding the traveller body in its seating (FIGS. **8** and **10**). The chamber in the drill unit, in which the drive gear **41** of the rotation motor, the bushing **39** for the drive rod **40** and the jack **44** are located, is filled with oil and closed by a seat member **76** of the drill unit. The seat member **76** is cut away in FIG. **8** along line **8—8** in FIG. **12.** The drive rod **40** extends into the seat member and is sealed off by suitable sealing rings. The seat member **76** of the drill unit forms a seat for the traveller body **18** which comprises an elongated cylindrical portion **77** and a body portion **78** with a frusto-conical rubber sleave **79** and four radial arms **80.** The cylindrical portion **77** of the traveller body is double-walled (FIG. **12**) and the inner cylindrical wall **81** forms a core barrel for a tubular retrieving member **82** which is suspended in the line **19.** The traveller body **18** is fastened at **86** to the line part **16** and runs at **87** along the line part **17** (FIG. **11**) and it can thus be pulled up and down between the ship and the main body **11** by means of the line **16,17.** A ring **88** is fastened to the seat member **76** and if the traveller body **18** is not in vertical position when landing on the main body, one of the arms **80** of the traveller body will abut the ring **88** so as to be pulled upright by the line **16,17** and thus facilitates seating.

A flush-water pump **89** is located in the water filled chamber **27** of the housing **24** of the main body and its intake opening for sea-water is connected to the chamber **90** which is be defined between the seat member **76,** the traveller body **18,** the sleeve **79** of the traveller body and an annular sealing ring **91** fastened to the seat member. A back pressure check valve **92** is arranged so as to admit sea water into the suction chamber **90** while still maintaining a partial vacuum in the suction chamber. The traveller **18** will therefore be firmly attached to the main body by suction as it lands. The outlet **93** of the flush-water pump **89** is connected to a valve **94** in the seat member. The valve **94** is biased into a position in which it admits the water from the pump into a passage **95** which leads to the cylindrical space above the drive rod **40** so that the flush water is forced into the drive rod during drilling. However, when the traveller body **18** is sealed properly, it actuates a lever system **96** so that the valve **94** shifts into the position shown in FIG. **12** in which position the water from the flush water pump **89** is admitted through another passage **97** and up between the walls of the cylindrical portion of the traveller body to the space above the retrieving member **82** which is thus pumped downward through the drive rod **40** and the drill pipe. Simultaneously with the valve **94** being shifted, a shut-off valve **98** is shifted to its open position in which it is shown in FIG. **12** so as to permit the retrieving member **82** to move into and through the drive rod. It is to be understood that the valves **94,98** and their leverages are shown very schematically and, preferably, the valves are interconnected as a single valve. The struts **36** can preferably be used as parts of the conduits for conveying the intake water from the drill unit to the water pump **89** and the outlet water from the pump **89** to the drill unit.

In FIG. **12** the retrieving member **82** is shown carrying an inner tube assembly **98** which has a pair of jaws **99** gripping a spearformed head **100** of the retrieving member. The retrieving member and the inner tube assembly **98** can be connected and disconnected and the inner tube assembly can be latched to the outer tube of the core barrel which outer tube carries a diamond core bit or a core bit with carbide inserts. The mechanisms for interconnection and disconnection are shown in detail but reference is instead made to U. S. specification 3,567,269.

The flush water pump **89** in the water filled chamber **27** of the housing **24** is driven by a chain drive by an electric motor **101** in the oil filled chamber. In the oil filled chamber, there are also a hydraulic pump **102,** for the hydrostatic drive of the rotation motor **38,** a hydraulic pump **103** for the hydraulic legs **12–12** and the

propeller 22, and a hydraulic pump 113 for the feed jack 35. The hydraulic pumps are driven by electric motors which have no casing but rotate directly in the oil and the pumps take their oil directly from the oil surrounding them. When the feed motor 35 is operated, the amount of low pressure oil will vary and this considerable fluctuation is taken up by the flexible cover 29.

In the water-filled chamber there is a small air chamber 110 with an inclination indicator 111 shown in FIG. 7 and having three interconnecting glass pipes partly filled with a conducting liquid and orientated towards the three legs 12–14. Four electrodes are connected to control lines in the cable 20 so that the inclination of the main body 11 is indicated on board the ship, and the level of the liquid can be varied at will by means of a motor actuated piston 112.

The operation of the drilling assembly will now be described with reference chiefly to FIG. 24 in which the shutter 68, the clamp or chuck 55, the casing clamp 60, and the chuck unit 47 are shown schematically. The magazine 31 is not shown in this figure.

When the main body 11 has been positioned on the seabed, the drill unit 34 is at first raised and the magazine 31 is turned until a casing tube 105 in the magazine is in alignment with the drive rod 40 and the chucks. The casing tube has an annular drill bit at its lower end and an adapter 104 at its upper end. The adapter is affixed to the casing tube by a bayonet joint and its upper end is threaded so that it can be connected to the drive rod 40. The casing tube 105 and its adapter 104 is shown in FIG. 21 and the upper part of the magazine is partly shown. The upper plate 65 of the magazine has a bushing with a number of rubber rings 107 which hold the adapter 104. The drill pipe clamp 55 is opened wide as in FIG. 17 and the shutter 68 and the casing clamp 60 are opened so as to permit introduction of the casing tube 105. The drill unit 34 is now lowered and the drive rod 40 is rotated so that the drive rod is screwed onto the adapter and the casing tube is drilled down into the seabed until an annular recess 106 in the upper part of the casing tube is just opposite the casing clamp. The casing clamp 60 is now actuated to hold the casing tube 105 as shown in FIG. 22 until the drilling operation is finished thereby anchoring the main body 11 in the casing tube. The drive rod 40 is turned backwards slightly and the drill 34 is then raised so that the bayonet joint between the adapter 104 and the casing tube 105 is disconnected. The adapter 104 is now clamped in the clamp 55 and the hydraulic jack 44 of the drill unit (FIG. 13) 13) is actuated to break the screw joint between the drive rod 40 and the adapter 104. The jack turns the drive rod 40 only about 30° and breaks therefore the joint without completely disconnecting it. The drill is raised until the adapter 104 becomes stuck in the rubber rings 107 and the drive rod 40 is rotated backwards so that it is disconnected from the adapter 104. The drill 34 is now raised to its upper end position, leaving the adapter 104 in the magazine as shown in FIG. 23.

Since the seabed can vary a great deal, the magazine 31 is normally provided with two casing tubes 105 with adapters 104. The two casing tubes have different length and the operator selects the one which he believes would suit the seabed best. The other is still in the magazine and will not be used.

The shutter 68 is now closed and the magazine 31 is turned a step so that the first drill pipe element — the outer tube of the double tube core barrel and the coring drill bit attached to this outer tube becomes aligned with the chucks and the clamps. The drill 34 is slowly lowered with the drive rod 40 rotating and, with the core barrel outer tube resting on the shutter 68, the drive rod will be screwed onto the core barrel outer tube, the magazine providing enough torque resistance. Now, the shutter 68 can be opened and drilling through the casing tube started. When the joint between the core barrel and the drive rod 40 has moved to just below the shutter 68, the core barrel is clamped in clamp 55, and the joint is broken and disconnected by means of the jack 44 and the rotation motor 38. The drill 34 is then raised, the magazine 31 turned another step and another drill pipe length is first screwed to the drive rod 40 and then to the core barrel.

Every time the core-receiving inner tube 98 of the core barrel is filled with a core or the core breaks and jams, the core barrel inner tube moves slightly upwardly in the core barrel outer tube and actuates a non-illustrated rubber ring at its upper end to block the flushing fluid. This results in a rise in the pressure of the flushing fluid, and since the pressure of the flushing fluid is indicated on the instrument panel on board the ship, the operator will always know when the core barrel inner tube 98 must be emptied. Then he stops the drilling and pulls the traveller body 18 down by means of the line 16,17. When the traveller body 18 seats on the drill 34, the retrieving member 82 with the spear 100 will automatically be pumped down through the drill pipe to the core barrel as described and the spear 100 will automatically latch the jaws 99 on the head of the inner tube. Then, when the line 19 is pulled, the inner tube 98 is freed from the outer tube simultaneously with the core being wedged off at its lower end. The retrieving member 82 with the inner tube is now lifted by the line 19 into the top position in the traveller body 18. During this lifting operation the fluid pressure from the flush water pump 89 can be maintained above the retrieving member which in this case should be provided with a relief valve for permitting a flow therethrough.

A solenoid valve 107 is now actuated to connect the outlet and the inlet of the pump 89 and because of leakage through the back pressure valve 92, the pressure in the suction chamber 90 will rise to the ambient pressure and the traveller body 18 can be pulled to the surface by means of the line 16,17 or the line 19. The inner tube 98 is emptied on board the ship, the traveller body 18 is again pulled down to seat on the drill 34, and the retrieving member 82 is pumped down into the bore hole to deliver the inner tube which automatically latches to the outer tube of the core barrel and at the same time is disconnected from the retrieving member. The retrieving member 82 is again pulled to the traveller body and the traveller body pulled to the surface or half way up to the surface where it is suspended until the inner tube again must be emptied.

The traveller body 18 can be used also for supplying the magazine 31 with drill pipe lengths when more drill pipe lengths are needed than can be stored in the magazine.

When the desired depth of the bore hole is reached, the drill pipe lengths are brought back to the magazine. To this end, the drill 34 is raised to its position in FIG.

24 in which the joint between the drive rod 40 and the uppermost drill pipe length 108 is in the middle of the double chuck 47 as in FIG. 24. The two sets of jaws of the double chuck are then actuated so as to grip and the chuck unit remains free to rotate. The break cylinder 44 is actuated to break but not completely disconnect the joint between the uppermost drill pipe length 108 and the remainder of the drill pipe 109 which is firmly held by the clamp 55, the double chuck 47 holding the joint between the drive rod 4 and the drill pipe length 108. Now the drill is lowered until the joint between the pipe length 108 and the remainder of the drill pipe 109 is just above the clamp 55, and this clamp is actuated to hold the drill pipe 109 while the drill pipe length 108 is unscrewed from the drill pipe 109 by means of the rotation motor 38. The double chuck 47 is axially movable to a limited extent slightly more than the length of the joint so as to allow this unscrewing. The drill 34 is now raised until the joint between the drive rod 40 and the pipe length 108 is again located in the middle of the double chuck 47 and the lower set of jaws 49 of the chuck is actuated to hold the pipe length 108 while the break cylinder 44 and the rotation motor 38 are used to unscrew the drive rod 40, the chuck being prevented from rotating by means of the jack 52. The shutter 68 is now closed and the pipe length 108 falls down on the shutter when the jaws of the double chuck 47 are released.

The magazine can now be turned another step with the pipe length 108 remaining in it. The drive rod 40 can be lowered through the magazine, screwed onto the drill pipe, and again raised to withdraw the drill pipe; and thus another pipe length can be inserted in the magazine. When all the pipe lengths have been inserted in the magazine, the magazine is turned until the casing adapter 104 is aligned with the drive rod 40, and the drive rod is screwed onto the adapter. The casing tube 105 is now pulled into the magazine and the joint between the adapter 104 and the drive rod 40 is disconnected.

The entire main body can now be lifted and positioned for drilling another bore hole without being lifted to the surface.

It is to be understood that the invention is not limited to the described embodiment but can be varied in many ways within the scope of the claims.

What I claim is:

1. In an off-shore drilling assembly: a main body adapted to be positioned on the sea bottom and including an axially movable drill for rotating a drill string which includes a core barrel assembly provided with a detachable and replacable inner tube assembly for receiving and retaining a core, and a feeding device for displacing the drill axially, and a traveller body adapted to travel between a floating structure and the main body along a flexible guide, carrying a core-containing core barrel inner tube assembly from the main body to the floating structure and an empty core barrel inner tube assembly from the floating structure to the main body, means for releasably anchoring the traveller body to said main body, and a device in the traveller body arranged to be lowered from the traveller body into the borehole for retrieving a core-containing inner tube assembly from the core barrel.

2. A drilling assembly as claimed in claim 1 in which the retrieving device is adapted to lower an empty inner tube assembly into the borehole alternatively to fetching a core-containing inner tube assembly from the borehole.

3. A drilling assembly as claimed in claim 1 in which said flexible guide comprises at least two lines for lowering the main body from the floating structure to the sea bottom, means for sensing the horizontal direction are arranged on the main body, and a propelling means is arranged on the main body for preventing rotation of the main body during said lowering of the main body.

4. A drill assembly as claimed in claim 1 in which a flush-water pump has its intake of sea-water at the upper portion of the drill, said traveller body and said upper portion of the drill define a closed suction chamber when the traveller body is seated on the drill, said inlet of seawater ends in said closed suction chamber, and a back-pressure check valve is arranged to permit sea-water to said closed chamber, said flush-water pump thereby providing said anchoring of the traveller body to the main body.

5. A drilling assembly as claimed in claim 1 in which the core retrieving device is suspended in a wire, a flush water pump is arranged so as to supply flush water to the drill string, a valve is arranged in the flush water supply conduit, and the traveller body is arranged to shift the valve into connecting the flush water pump outlet to a space in said travelling body at the rear of said retrieving device so that said retrieving device is pumped down into the bore hole when the travel body seats on the drill.

6. A drilling assembly as claimed in claim 1 in which said feeding device comprises a vertical double-acting hydraulic jack which is mounted on the main body and carries the drill axially movably.

7. A drilling assembly as claimed in claim 6 in which an arm structure with an elbow-joint is pivotably connected between the unmovable part of the main body and the drill.

8. A drilling assembly as claimed in claim 6 in which the drill includes a drive rod onto the lower end of which a drill string element can be screwed, and a reversible rotation motor for rotating the drive rod, and the main body further comprises a freely rotatable chuck unit having two independently fluid actuated sets of chuck jaws, the upper of the sets of jaws being adapted for gripping the drive rod and the lower of the sets of jaws for gripping a drill string element when such a drill string element has been screwed to the lower end of the drive rod and the drill is in an upper position, said chuck unit being axially movable, a fluid actuated means for locking said chuck unit against rotation, a magazine below said chuck housing and arranged to store a casing tube and a number of drill string elements, a drill string clamp below said magazine, and a casing tube clamp below said drill string clamp.

9. A drilling assembly as claimed in claim 1 in which the main body is provided with sheave means and said flexible guide comprises a line deviated over the sheave means so that the main body can be lowered from the floating structure and lifted to the floating structure in the line.

10. A drilling assembly as claimed in claim 9 in which the traveller body is adapted to be clamped to one part of said line and guided on the other part so that it can be pulled up and down between the floating structure and the main body by means of the line.

11. In an off-shore drilling assembly: a remote controlled main body arranged to be positioned on the sea bottom from a floating structure and including a drilling device for rotating and feeding a drill string, a watertight housing filled with oil and being a part of the main body, an oil pump in the housing taking oil directly from the oil surrounding it and delivering pressure oil to a hydraulic motor, means for returning low pressure oil to the housing from the hydraulic motor, an electric motor in the housing driving the oil pump, an electric power line from the floating structure to the electric motor in the housing, and an oil accumulating device taking up the fluctuations in volume of the low pressure oil.

12. A drilling assembly as claimed in claim 11 in which the accumulating device is a flexible wall member of the housing.

13. A drilling assembly as claimed in claim 11 in which at least one of the hydraulic jacks outside said watertight housing are supplied with pressure oil from said oil pump in the housing.

14. A drilling assembly as claimed in claim 11 in which the main body has three adjustable legs, and the housing is annular so as to allow the drill string to extend through the housing into the bore hole.

15. A drilling assembly as claimed in claim 14 in which the legs are adjustable by means of pressure oil delivered from said oil pump.

16. A drilling assembly as claimed in claim 14 in which a revolving magazine for a plurality of drill string elements extends into the opening of the housing.

17. A drilling apparatus arranged to be positioned on the sea bottom, lowered from a floating structure, and comprising: a frame work, means for supporting the frame work on the sea-bed, an axially movable drill including a drive rod onto the lower end of which a drill rod length can be screwed and a reversible rotation motor for rotating the drive rod, a feed motor for displacing the drill axially, a rotatable chuck unit mounted on said frame work and having two independently fluid actuated sets of chuck jaws, an upper of the sets of jaws being adapted for gripping said drive rod and the lower of the sets of jaws for gripping a drill rod length when such a drill rod length is screwed to the lower end of the drive rod and the drill is in an upper position, said chuck unit being axially movable, a fluid actuated means for locking said chuck unit against rotation, a magazine below said chuck housing and arranged to store a casing tube and a number of drill rods, a drill rod clamp below said magazine, and a casing tube clamp below said drill rod clamp.

18. A drilling apparatus as claimed in claim 17 in which the feed motor is an upright double acting hydraulic feed jack which is a part of the frame work, and the drill is mounted on the piston rod of the feed jack.

19. A drilling apparatus as claimed in claim 18 in which articulated struts for taking up reaction torque is mounted between the cylinder of the feed jack and the drill.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,741,320 Dated June 26, 1973

Inventor(s) Karl Erik Hilfing

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 4, line 4; "core" has been cancelled

Col. 4, lines 42 and 44, "98" has been changed to --94--

In Fig. 12, the shut off valve numbered "98" in the lower right corner has been renumbered --94--.

Signed and sealed this 7th day of January 1975.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents