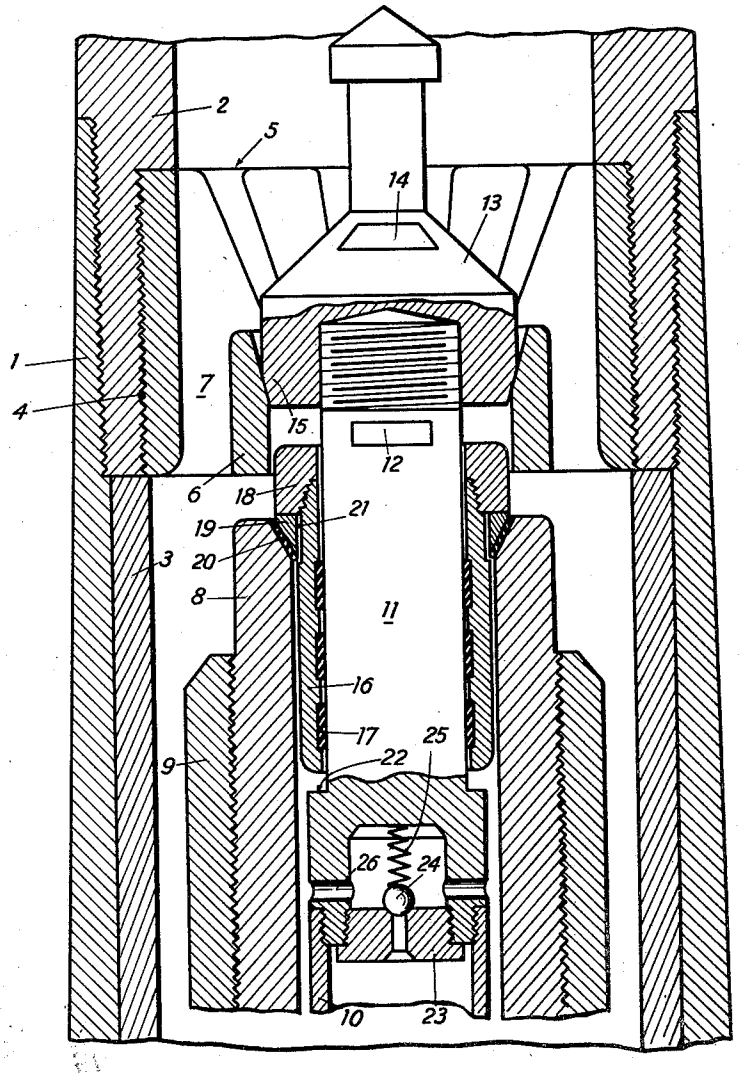
Sept. 25, 1962 W. TIRASPOLSKY ET AL 3,055,440

TURBO-COREDRILL FOR GROUND DRILLING

Filed Oct. 27, 1958 2 Sheets-Sheet 1

FIG. 1



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Filed Oct. 27, 1958 2 Sheets-Sheet 2

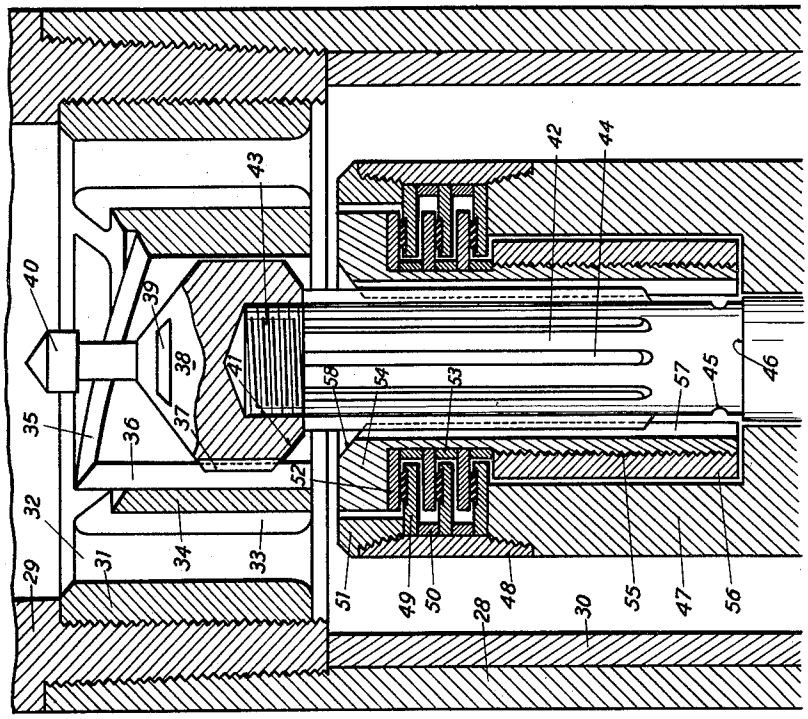


FIG. 2

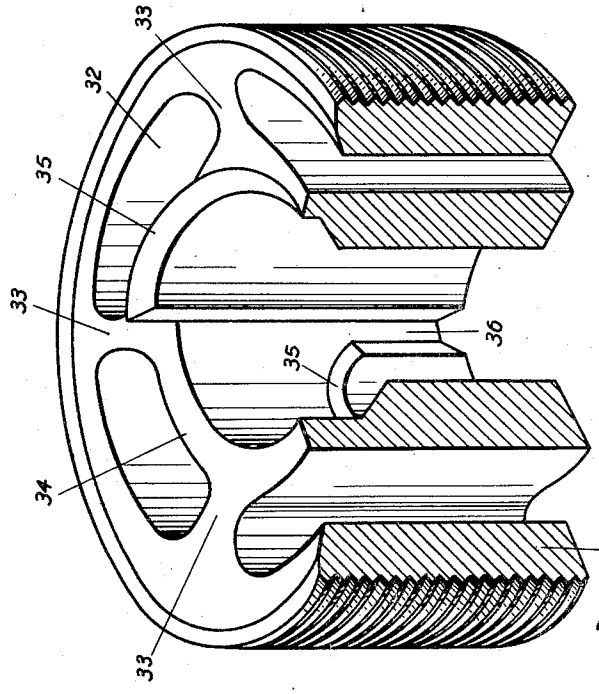


FIG. 3

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TURBO-COREDRILL FOR GROUND DRILLING

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7 Claims. (Cl. 175—107)

The present invention relates generally to coredrills as utilized when drilling the ground for bringing up to the earth surface cores or samples of those layers of ground through which the drilling operation is performed.

Turbo-coredrills as manufactured and used hitherto and more generally coredrills actuated by a subterranean motor comprise a rotary hollow shaft through which a retractable inner core tube is engaged, said core tube resting upon an annular seat provided over the top end of said shaft and operatively connected to the stator structure of the motor. The tubes adapted to collect the cores are usually provided with a fishing head which allows to bring them up by means of a special gripping tool (overshot) which is lowered inside the rods and is fastened to the end of an operating cable.

An annular space should accordingly be provided between the rotary shaft of the motor and the inner core tube. If the radial size of said annular space is too small, a friction takes place between the shaft and the inner core tube, which may either damage said tube or impart a rotary bias thereto. Where, conversely, said annular space is too wide, an appreciable portion of the operative fluid then flows through the resultant channel.

The fluid stream which is derived owing to this phenomenon is subtracted from the working steam of the turbine and maintains in the aforesaid annular space unduly high pressures which may hinder proper outflow of the fluid at the upper end of the inner core tube as the core gradually penetrates into it. Now the efficiency of a coredrill (expressed in percentage of the recovered core) is among other factors subordinated to the possibility of doing away with any substantial over pressure inside the inner core tube which is usually fitted with a relief valve. Where accordingly high pressures prevail inside the aforesaid annular space, this has the effect of diminishing the length of the core that can be obtained in each run. In turbo-coredrills as used at present the maximum core length is generally smaller than about fifty percent of the total length of the core tube.

An object of the invention is to remedy the disadvantage above referred to of coredrills as at present in use and to provide a novel or improved coredrill capable of furnishing, when properly used, cores of greater length than present coredrills owing to a better "coring" efficiency.

Another object of the invention is to provide a turbo-coredrill of improved structure comprising a retractable inner core tube adapted to be replaced in the course of the drilling operation without any need for the rods to be raised out of the well being bored and characterized by the provision at the upper end of the inner core tube and/or the turbine shaft of a device which obturates the annular space defined between the inner core tube and the hollow shaft of the turbine so as to prevent the fluid from flowing through said annular space or to limit the fluid flow to that minimum value which is necessary for lubricating the device.

A further object of the invention is to provide a turbo-coredrill as aforesaid wherein the above-cited device is so built as to form an abutment or bearing carrying the inner core tube which thus rests axially on the head of the hollow turbine shaft instead of being axially maintained in the usual fashion on a seat formed in the stator, this construction permitting to avoid axial movements of the lower end of the inner core tube with respect to the rock, said movements being unavoidable with a coredrill of usual construction on account of the relative axial hunting motion which takes place between the stator and the rotor within the boundaries of permissible axial clearances which, as is known, do not represent a constant value but a value which increases as the thrust bearings gradually become worn off.

A still further object of the invention is to provide an improved turbo-coredrill as aforesaid wherein the obturating device may be operatively combined with an additional device locking the inner core tube in a fixed angular position relatively to the stator so that the inner core tube may not rotate while coring occurs.

The position of the cores with respect to the stator is thus fixed and if desired means are therefore available for taking spatially orientated cores.

It will be understood that while throughout the specification reference is made to turbo-coredrills i.e. to the application of the invention to turbines for drilling the ground particularly for the exploitation of oil fields, the invention is applicable in a more general way to any type of underground or subterranean motor or prime mover used for coring and particularly to electric motors.

It will be also understood that the device for angularly setting the inner core tube may be also used for angularly setting the dip-measuring apparatus which may, at the end of a coring phase or at any desired time, be substituted for the inner core tube, thereby permitting the stator to be angularly set or orientated with respect to the azimuth of the bore hole dip as soon as said hole shows a measurable degree of deviation.

With the foregoing and such other objects in view as will incidentally appear hereafter, the invention comprises the novel construction and combination of parts that will be now described with reference to the accompanying diagrammatic drawings exemplifying the same and forming a part of the present disclosure.

In the drawings:

FIGURE 1 is a partial vertical sectional view of an improved turbo-coredrill according to the invention.

FIGURE 2 is a view similar to FIG. 1 showing a constructional modification.

FIGURE 3 is a perspective view partly broken away of a constructional detail.

In the showing of FIG. 1, the tubular casing body member portion 1 of the turbo-coredrill terminates at its upper end in a joint or union 2 which provides a lower shoulder against which the upper part or element 3 of the stator part stack is abutted. A left-handed thread 4 of the joint 2 receives the seat 5 of the inner core tube which is screwed into it and is thus rigidly connected relative to the stator. The seat 5 has a central conical crown member 6 and peripheral circulation channels 7.

The revoluble shaft 8 of the turbo-coredrill is rigid with the stack of rotor parts. For the sake of clearer illustration, only the upper lock nut 9 of said rotor stack and the upper part 3 of the stator have been shown. The shaft 8 is hollow and permits free passage therethrough of the inner core tube 10 whose top joint is indicated by 11. Said joint is provided with spanner-receiving notches 12 and is screwed at its top end into the head 13 of the inner core tube 10 which is provided likewise with spanner-receiving notches 14. Said head sits upon its lower conical bearing surface 15 upon the conical abutment surface of the inner crown member 6 of the seat 5.

According to the invention, a sleeve-shaped rotary sealing device 16 fitted internally with rubber or like gaskets 17 adapted to be applied against the outer face of the upper

joint 11 of the inner core tube 10 is interposed between said sealing device and the rotary hollow shaft 8. Said joint is held in position by a top shoulder nut 18 which provides in cooperation with the upper part of shaft 8 an annular recess in which is received a conical ring member 19 which ensures a sealing effect and rests along a supple coating 20 (made for example of rubber) against the conical seat formed (as shown) at the top end of the rotary shaft 8. A certain amount of clearance is provided as shown at 21 between said conical ring member and the sealing device 16 so as to allow said ring member to move radially with respect to the sealing device 16 and to the nut 18, thereby eventually compensating for the eccentricity of the shaft 8 with respect to the seat 5.

The upper joint 11 of the inner core tube has a shoulder 22 which acts as an abutment surface for the rotary sealing device when extracting the core tube 10. There is provided at the lower end of the joint 11 a thread for securing a valve seat 23 against which a valve ball 24 is normally applied by a spring 25, the fluid escaping through a vent 26.

During operation, the head of the inner core tube 10 rests against the inner crown member 6 of the seat 5 to which it is applied owing to the difference of pressure which prevails between the inlet and the outlet of the turbine. The rotary sealing device 16 rests in turn against the conical bearing provided on the shaft 8 and is pressed against said shaft by the aforesaid pressure difference. As the sealing device 16 is revolubly driven by the rotating shaft 8, it rotates about the upper joint 11 of the inner core tube 10. Rotation is facilitated by the gaskets or bearing lines 17. Thus said sealing device seals off the annular gap defined between the inner core tube and the shaft, but the gaskets or bearing liners 17 obviously allow a reduced flow of liquid for lubricating said gaskets in a well-known manner.

According to the constructional modification which is shown in FIG. 2 in which the head of the inner core tube rests on the shaft head while being angularly held in a stator seat, the body 28 of the turbo-coredrill carries a top joint 29 forming an abutment for the upper end 30 of the stator stack. A threaded portion on the joint 29 permits the guiding seat 31 of the inner core tube to be mounted thereon, said guiding seat including (see FIG. 3) channels 32 for the fluid flow, ribs 33, a crown member 34 and a helical ramp 35 the upper and lower outsets of which are visible in FIG. 3, while the end portions of said ramp define a vertical key slot 36. In this slot 36 is normally received a single key rib 37 which projects from the periphery of the head 38 of the inner core tube which is provided with spanner-receiving notches 39 and is surmounted by a so-called fishing mushroom 40. The head 38 is provided adjacent its lower end with a conical bearing surface having an anti-abrasive coating 41. The upper joint 42 of the inner core tube is screwed through an inner thread 43 in the head 38, said joint 42 having driving flutes 44 the purpose of which is indicated hereafter. The reference numeral 45 designates the vent of the inner core tube valve, while the reference numeral 46 designates the upper shoulder on said tube.

The revoluble shaft 47 of the turbo-coredrill is fitted adjacent its upper end with a bearing or abutment joint 48 for mounting rubber bearing seats 49 and spacer sleeves 50, the assembly being clamped by a locking nut 51. The rubber seats 49 cooperate with wear-taking discs 52 which are mounted with spacer sleeves 53 on a stationary bearing body 54 having a lower threaded portion 55 on which is screwed a bearing-carrying nut 56. Said bearing body 54 is sleeve shaped and provides together with the discs 49, 52 an annular, substantially sleeve-shaped sealing device between shaft 47 and the inner core tube 42. Said body 54 is fitted on its inner periphery with longitudinally extending flutes 57 matching the flutes 44 in the upper joint 42 of the inner core tube.

The operation of the device is as follows: When the device occupies its normal working position, the coating

41 provided on the head 38 of the inner core tube rests upon the conical bearing surface 58 of the bearing body 54 and provides a sealing effect. The gap defined between the inner core tube and the rotary hollow shaft 47 is obturated in the present case both by the head bearing and by the bearing body 54 acting as a sealing device. Consequently only the portion of fluid which is necessary for irrigating the bearings 49 and 52 is allowed to flow between the bearing body 54 and the locking nut 51. In such normal position, the inner core tube is angularly locked with respect to the body of the coredrill and to the stator, said angular locking being obtained in the following manner as the inner core tube is positioned:

As the inner core tube is lowered by a free fall through the hollow rods and as said tube reaches the turbo-coredrill, the rib 37 rests upon the ramp 35 and the part 31 which is rigid with the stator, said two elements being so treated as to resist mechanical strains resulting from said contact. When this occurs, the flutes 44 in the joint 42 are already partly engaged between the flutes 57 in the bearing body 54, thereby ensuring guidance of the head of the inner core tube. The rib 37 which rests upon the ramp 35 becomes aligned with and received within the groove 36 as soon as an angular motion of the shaft 47 creates a torque in the bearing 49–52 to rotate the body 54. As soon as the rib 37 is received into the slot 36, the head of the inner core tube moves downwardly under gravity forces engaging the coating 41 with the conical seat 58 of the bearing body 54. From that moment on the inner core tube is connected for joint angular motion with the stator or body of the turbo-coredrill and has a definite angular setting, i.e., is oriented with respect to it. However the inner core tube remains free to be moved axially with respect to the stator, and the axial position of the lower end of said tube remains stable relative to the drilling tool. The bearing body 54 and the discs 52 are held stationary by the inner core tube through the medium of the flutes 44 and 57.

Where, for example, owing to the size of the parts, the torque transmitted between the shaft 47 and the head 38 of the inner core tube is insufficient for ensuring such an angular displacement of said head as to bring the rib 37 into registration with the slot 36, said torque can be easily increased by interposing a resilient member between the part of the bearing which is rigid with the shaft 47 and that one which engages the flutes of the inner core tube, thereby bringing into contact the oppositely located faces of the discs 52 and the seats 49, said faces having a sufficient coefficient of friction for ensuring a positive drive of the head on the ramp 35.

Minor constructional details may be varied without departing from the scope of the subjoined claims.

What is claimed is:

1. In a turbo-coredrill actuated by a circulating fluid and including a tubular body portion, a stator part mounted in said body portion, a hollow shaft rotatably mounted within said body portion, rotor part fitted upon said hollow shaft, and a retractable inner core tube having a fishing head and received within said hollow shaft and defining an annular space therewith, means associated with said head axially positioning said tube within said shaft; a sleeve-shaped sealing device interposed between said inner core tube and the upper end of the hollow shaft for substantially obturating said annular space and for substantially preventing the flow of the circulating fluid through said space, first axial extending key means on said body portion, and second axial extending key means mounted on said tube for cooperative relation with said first key means for angularly locking the inner core tube with respect to said body portion.

2. In a turbo-coredrill actuated by a circulating fluid and including a tubular body portion, a stator part mounted in said body portion, a hollow shaft rotatably mounted within said body portion, rotor parts mounted

upon said hollow shaft, a retractable inner core tube having a fishing head and received within said hollow shaft defining an annular space therewith, a sleeve-shaped sealing device interposed between said inner core tube and the upper end of said hollow shaft for substantially obturating said annular space and for substantially preventing fluid flow through said space, first bearing means at the upper end of said hollow shaft, an outwardly directed shoulder portion carried by said sleeve-shaped sealing device, second bearing means associated with said shoulder portion, the second bearing means associated with the sealing device resting against the first bearing means associated with the shaft and permitting relative angular motion therebetween, inner flutes axially formed on the sleeve-shaped sealing device, outer flutes axially formed on the upper end of the inner core tube and cooperating with said inner flutes, a seat portion at the upper end of said sealing device, the head of the inner core tube sealingly engaging said seat portion, first key means rigidly associated with said body portion, and second key means formed on said head and cooperating with the first key means for holding said head against angular movement relative to said body portion.

3. In a turbo-coredrill actuated by a circulating fluid and including a tubular body portion, a stator part mounted in said body portion, a hollow shaft rotatably mounted within said body portion, rotor parts mounted upon said hollow shaft, a retractable inner core tube having a fishing head affixed to the upper end thereof received within said hollow shaft and defining an annular space therewith, a seat member having a central bore affixed to said body portion vertically above said hollow shaft, said tube being lowered into said shaft through said seat member bore and an abutment surface defined on said head engaging said seat member to axially locate said tube within said shaft, axial extending channels defined in said seat member extending therethrough, an annular sleeve-shaped sealing device interposed between said tube and the upper end of said shaft substantially obturating said annular space to substantially prevent the flow of circulatory fluid into said shaft, annular gaskets mounted in the bore of said sealing device sealingly engaging said tube and permitting relative rotation between said sealing device and said tube, an annular seat defined on the upper end of said shaft adjacent the bore thereof, a shoulder defined on said sealing device sealingly engaging said annular seat upon said head engaging said seat member, means defined on said tube engaging said sealing device upon withdrawing said tube from said shaft, withdrawing said sealing device from said shaft and passages defined in the wall of said tube located below said sealing device.

4. In a turbo-coredrill as in claim 3 wherein said sealing device is axially positionable upon said core tube.

5. In a turbo-coredrill as in claim 2 wherein a guiding seat is mounted within said body portion and affixed thereto, said first key means being defined on said guiding seat, axial extending channels defined in said guiding seat and extending therethrough, a bore defined in said guiding seat through which said core tube is inserted, an annular helical surface defined in said bore, the lower end of said helical surface intersecting said first key means, said second key means engaging said helical surface upon insertion of said tube into said shaft and engaging said first key means upon relative rotation of said tube in the shaft rotating direction.

6. In a turbo-coredrill actuated by a circulating fluid and including a tubular body portion, a stator part mounted within said body portion, a hollow shaft rotatably mounted within said body portion, rotor parts mounted upon said shaft, a retractable inner core tube having a fishing head affixed thereto received within said shaft defining an annular space therewith, a seat defined on said body portion above said shaft, said core tube head engaging said seat, circulation channels defined in said seat, a sleeve-shaped sealing device interposed between said tube and the upper end of said shaft substantially obturating said annular space and substantially preventing flow of the circulating fluid through said space, said sealing device defining a small annular space with said inner core tube, bearing means interposed between said sealing device and tube within said small annular space, a shoulder defined on said sealing device engaging the upper end of said hollow shaft, and a passage defined in the wall of said tube below said sealing device.

7. In a turbo-coredrill actuated by a circulating fluid and including a tubular body portion, a stator part mounted in said body portion, a hollow shaft rotatably mounted within said body portion, rotor parts mounted upon said shaft, a retractable inner core tube having a fishing head and received within said hollow shaft and defining an annular space therewith, a sleeve-shaped sealing device interposed between said inner core tube and the upper end of said hollow shaft for substantially sealing off said annular space and for substantially preventing a flow of the circulating fluid through said space, an outwardly directed shoulder portion on said sealing device for abutment against the upper end of said hollow shaft, a seat portion in the upper end of said sealing device, the head of the inner core tube resting against said seat portion, first key means affixed to said body portion, and second key means mounted on said fishing head engageable with said first key means for locking said tube against rotation relative to said body portion.

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