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CORING AND FLUID SAMPLING DEVICE

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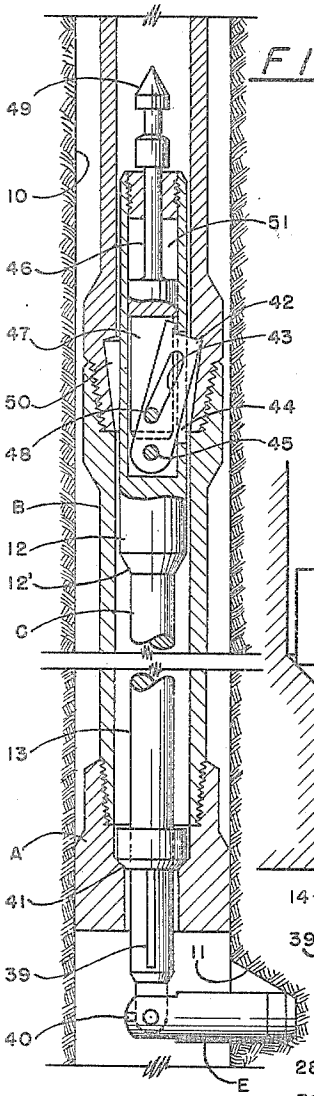


FIG. 1.

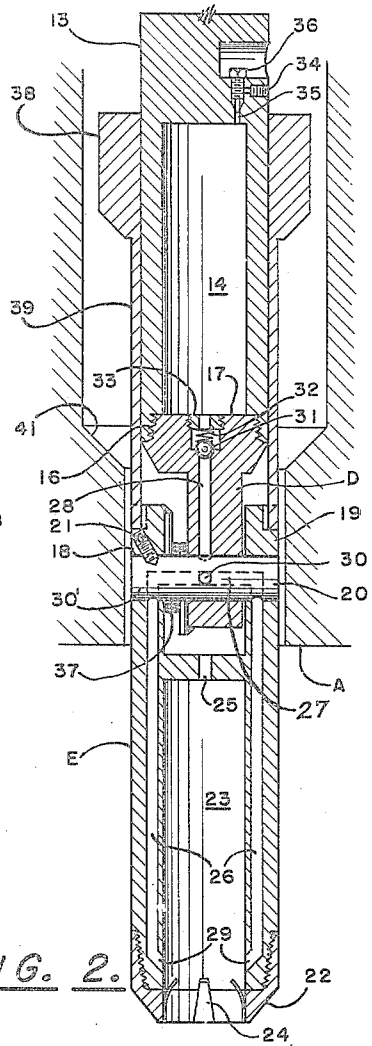


FIG. 2.

FIG. 3.

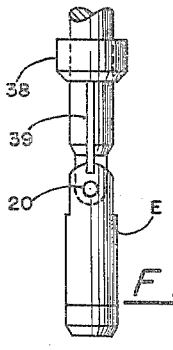


FIG. 4.

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CORING AND FLUID SAMPLING DEVICE

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1 Claim. (Cl. 255—1.4)

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The present invention is directed to a device for simultaneously taking a side wall core and a fluid sample and for sealing the fluid sample under the pressure at which it is obtained.

An object of the present invention is to provide a device which may be operated through a conventional core bit to take a side wall core and a fluid sample and which may be retrieved by a wire line without withdrawing the core bit from the borehole. Another object of the present invention is to provide a device which may be operated through a conventional core bit and is capable of taking a side wall core and a separate sample of fluid from adjacent points in a borehole.

It is a further object of the present invention to provide a device which may be operated through a conventional core bit to take a side wall core and a fluid sample substantially simultaneously and which seals the fluid sample under the pressure at which it is obtained.

Other objects and advantages of the present invention may be seen from a reading of the following description taken with the accompanying drawing in which

Fig. 1 is an elevation of an embodiment of the present invention shown in position in the lower end of a drill stem and in the act of securing a side wall core and a fluid sample;

Fig. 2 is a view of the lower end of the embodiment of Fig. 1 as it is being lowered into position adjacent the drill bit and with the parts locked to allow it to be moved freely downwardly through the drill stem;

Fig. 3 is a fragmentary view of the lower end of the device of Fig. 1 with the several parts in the position assumed for taking a core as in Fig. 1 and showing in greater detail the construction of the device; and,

Fig. 4 is an elevation of the lower portion of the embodiment of the preceding figures with the parts in the same relative position as in Fig. 2 but turned through an angle of 90°.

The apparatus of the present invention may be described briefly as a wire line sampling and side wall coring apparatus. This device is adapted to be used in conjunction with a drill bit provided with a central passage, such as is conveniently used for taking cores from the bottom of the hole, and is arranged to be moved longitudinally along the longitudinal axis of the drill stem and to be locked releasably to the lower end of the drill stem adjacent the drill bit. When preparing to take a side wall core and sample, the device may be lowered on a wire

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line or allowed to drop under the influence of gravity through the bore of the drill pipe until it reaches its seat adjacent the drill bit. When a side wall core and sample have been taken the apparatus may be released from its position adjacent the drill bit and withdrawn to the surface of the earth by means of a wire line.

Turning now specifically to the drawing and first to Fig. 1 a fish tail bit A of the design commonly employed for cutting cores during normal drilling operations is secured to the lower end of a drill stem B; it will be understood that only a lower portion of the drill stem is shown by the drawing. Arranged in position for taking a side wall core and a fluid sample of the formation is an embodiment of the present invention which is constructed with an elongated body C, hinge member D and a core barrel or core taking tube E. The drill bit and drill stem are shown in position in a section of a borehole 10 penetrating a formation 11; the core taking tube E projecting below drill bit A and its open end extending into formation 11.

It will be understood that the borehole 10 extends below and above that portion shown in the drawing and that the drill stem continues to the surface of the earth where it is connected with conventional rotary drilling equipment. Rotary drilling is a well known operation in the art and the surface equipment employed for this purpose is conventional and for the purpose of simplifying the description of the present invention a showing of such equipment is omitted from the drawing.

Body C of the sample taking device may be a unitary member with an upper cylindrical portion 12, a lower cylindrical portion 13 of a smaller diameter than the upper portion and a ledge 12' joining the two cylindrical portions. A chamber 14 for receiving a liquid sample may be provided in body C by drilling or otherwise removing metal from the lower portion of body C.

A hinge member D has its upper end secured to the lower end of body C by suitable means, such as mating screw threads 16. The upper face 17 of member D defines the lower wall of cavity 14. The lower end of member D is provided with a transversely extending passage adapted to receive pin 20; the dimensions of the passage are selected to allow pin 20 to rotate with respect to member D while at the same time the clearance between pin 20 and member D is sufficiently close to prevent or substantially prevent leakage between the pin and the passage. A passage 28 extends parallel with the longi-

tudinal axis of hinge member D to connect the transverse passage through which pin 20 extends with the face 17. The upper end of passage 28 is provided with a check valve including ball 31, spring 32 and bushing 33.

Pin 20 is provided with longitudinally extending passage 27, radially extending passage 30, and radially extending passages 30'. It will be seen that passage 30 communicates with a central portion and passages 30' communicate with the ends of passage 27, the longitudinal axis of passage 30 making an angle of approximately 90° with the longitudinal axes of passages 30'. The upper end of barrel E is shaped to form the spaced abutments 18 and 19 which are pierced with passages to receive the ends of pin 20. Pin 20 is secured in fixed position with respect to tube E by means of screw 21, tube E and pin 20 being arranged for movement as a unit with respect to hinge member D.

The lower end of sample-taking tube E is provided with a knife edge 22 adapted to be thrust into the side of the borehole for cutting a side wall core. Within tube E is core receiving cavity 23 with flexible sample retaining means 24 arranged at the lower end thereof. The upper wall defining chamber 23 is pierced by passages 25 which allow fluid to be expelled from the cavity as the sample enters in the taking of a side wall core. Tube E is provided with longitudinally extending passages 26. The lower ends of passages 26 communicate with the lower end of chamber 23 through inlets 29 and the upper ends thereof to communicate with passages 30' of pin 20.

When the longitudinal axis of sample taking tube E makes an angle of approximately 90° with a longitudinal axis of body C, fluid communication between cavity 14 in body C and the lower end of tube E is provided by passages 28, 30, 27, 30', 26 and inlets 29. When the longitudinal axis of tube E makes an angle somewhat less than 90°, such as less than 80°, or somewhat greater than 90°, such as greater than 100°, communication between passages 28 and 30 is terminated, and hinge member D and pin 20 act as a closed valve to prevent communication between cavity 14 and outlets 29.

It is preferred to arrange passages 30 and 28 so that fluid may flow from inlets 29 to cavity 14 when the longitudinal axis of tube E makes an angle with the longitudinal axis of body C within a range of 80° to 110°. It will be understood that the angle at which there is communication between inlets 29 and cavity 14 may be varied somewhat and that the range may be larger or smaller than the preferred range given and also the angles may be greater or less than that given. Usually, it will be desirable for the valve to be open when tube E makes an angle of 90° with body C and to be closed when the angle becomes greater than 100° or less than 80°.

The fluid sample trapped in cavity 14 may conveniently be removed by an operator at the surface of the earth through outlet 34. It will be seen that outlet 34 extends radially inwardly at a point slightly above cavity 14 and communicates through passage 35 with cavity 14. Passage 35 defines a seat for the conical point of screw 36, the seat and screw serving as a valve to prevent communication between outlet 34 and cavity 14 until it is convenient to withdraw the sample from cavity 14.

The arrangement of a means for latching the longitudinal axis of tube B parallel with the longitudinal axis of body C and for deflecting the open end of tube E against a formation for taking a side wall core when the locking means is released does not in itself form a part of the present invention. A device for taking a side wall core through a drill bit with means for biasing the open end of the core taking tube against the formation is described and claimed in copending application Serial No. 473,158, filed January 22, 1943, now Patent No. 2,389,208, issued November 20, 1945. The means for deflecting the open end of core taking tube E against the formation when taking a side wall core is a coil spring 37 arranged around pin 20 between end portion 18 of tube E and hinge member D, with one end of spring 37 secured to tube E and its other end secured to hinge member D.

The latching means provided for retaining the longitudinal axis of barrel E in line with the longitudinal axis of body C includes annulus 38 slidably arranged on portion 13 of body C and having members 39 extending downwardly from annulus 38. End portions 18 and 19 are provided with notches 40 shaped to receive the lower ends of members 39.

The upper end of the device is provided with a releasable latch for securing it to the drill stem while taking a core and a fluid sample. This latch is arranged to become operable after the lower ends of members 39 have been released from notches 40 by relative movement between annulus 38 and tube E in the manner described in the preceding paragraph. The means for latching the sample taking device to the drill stem includes a latch 42 provided with a slot 43. Latch 42 is positioned in a slot 44 in portion 12 of body C and has its lower end pivoted to the body by cross pin 45. A latch actuator comprising a stem 46 and bifurcated lower end portions 47 is provided with a cross pin 48 which works in slot 43 of the latch. The latch actuator is arranged for longitudinal movement in passage 51 of the device. The upper end of stem 46 projects above body C and is surmounted by a head 49 suitable for engagement with a wire line grappling tool. The means above described for latching body C to drill stem B is conventional to the art. It will be apparent that latch 42 will be retracted within body 12 as the device is lowered through the drill stem but its upper end is moved laterally outwardly to engage notch 50 in drill stem B when body C reaches the position relative to the drill stem and drill bit shown in Fig. 1 with latch 42 adjacent notch 50. It will also be evident that the latch may be released with the use of a wire line grappling tool engaging head 49 by placing sufficient tension on the wire line to move upwardly stem 46 and cross pin 48.

When preparing the apparatus for lowering through a drill stem preparatory to taking a side wall core and fluid sample, the tube E is locked in position as shown in Figs. 2 and 4. It will be seen that the longitudinal axes of tube E and body C are parallel and tube E is retained in this position by lowering annulus 38 until the lower ends of members 39 engage notches 40. It will be understood that chamber 14 and cavity 23 are adapted to receive a fluid sample and a side wall core respectively, that is to say, chamber 14 may be filled with air under atmospheric pressure and cavity 23 is free from solids. The device may then move downwardly through the drill stem either by dropping it into the drill stem at the surface and allowing it to fall under the influence of gravity or by lowering it at the end of a wire line. After the device reaches the lower

end of the drill stem, barrel E, hinge D and the lower portion of body C pass below the cutting edge of bit A, and the underside of annulus 38 seats on ledge 41 of bit A. Continuing downward movement of body C releases members 39 from notches 40 of tube E and allows the free end of the tube to be deflected against the wall of the borehole. When body C has moved downwardly a sufficient distance to release tube E, latch 42 at the upper portion of body C is adjacent notch 50 of the drill stem and is in position to latch body C against upward movement as shown in Fig. 1. If body C moves downwardly beyond the position shown in Fig. 1, its downward movement will be limited by the engagement of ledge 12' with annulus 38 and ledge 41 and when manipulating the drill stem to take a sample, the drill stem will be moved downwardly with respect to body C and will cause the device to latch to the drill stem as shown in Fig. 1, while the side wall core and fluid sample are being taken.

After body C has been lowered into the drill stem so that latch 42 engages notch 50 of the drill stem and tube E is released so that its lower end is deflected against the side wall of the borehole, a sample may be taken by lowering the drill stem a relatively short distance to force the open end of tube E outwardly into the wall of the hole. The device is shown in the position of taking a side wall core in Figs. 1 and 3. As the drill stem is moved downwardly to force the open end of tube E into the side wall of the hole, tube E and pin 20 rotate about the axis of pin 20 until the longitudinal axis of tube E makes an angle of approximately 90° with the longitudinal axis of body C and when this relative position of the two parts is reached, the inlet 29 of tube E is fluidly connected to chamber 14 of body C so that a fluid sample may pass from opening 29 to chamber 14. When the axis of tube E makes an angle either substantially greater or substantially less than 90° with the axis of body C, the chamber 14 is sealed so that at least the principal part of the fluid sample retained within chamber 14 is taken from the same formation as the side wall core.

When body C is locked to drill stem B by the engagement of latch 42 with notch 50 as shown in Fig. 1 the means locking the longitudinal axis of tube E in line with the axis of body C will have been released by relative movement between annulus 38 and tube E and the open end of tube E will be deflected against the side wall of the borehole. The lowering of the drill stem a relatively short distance will then force the open end of tube E into the wall of the bore to take a sample. The device in the position of taking a side wall core is shown in Figs. 1 and 3. Upon downward movement of the drill stem to force the open end of tube E into position, its longitudinal axis will assume an angle of approximately 90° with the longitudinal axis of body C and when this relative position of the two parts is reached the passage connecting inlet 29 adjacent the lower end of tube E and cavity 14 in body C will be opened to allow fluid to pass from opening 29 to cavity 14.

After the drill stem has been moved downwardly to cut a side wall core and obtain a fluid sample the drill stem may be raised in order to withdraw the core taking tube from the formation; this results in the angular movement of pin 20 with respect to member 15 and closes the passage between inlet 29 and cavity 14. The core barrel may then be released from the drill stem by moving stem 46 upwardly by manipulation of a wire line and may be withdrawn to the surface of the earth. When the device reaches the surface of the earth, the side wall core may be removed from tube E in the conventional manner and the fluid sample withdrawn from cavity 14 by connecting a suitable container to outlet 34 and turning screw 36 to allow communication from cavity 14 through passage 35 to outlet 34.

Having fully described the preferred embodiment of the present invention, what we desire to claim is:

An improved sample taking device adapted for movement along a drill stem and for simultaneously taking a side wall fluid sample and a side wall core sample through a core bit attached to a drill stem comprising, in combination, an elongated cylindrical body defining a fluid sample chamber in the lower end thereof, releasable latching means arranged at the upper end of said body to latch it to said drill stem, a tubular shaped core barrel provided with notches in its upper end and having a longitudinal fluid passage in its walls extending from the lower end into the upper end thereof, means journalling the upper end of said core barrel to the lower end of said body, said journalling means having fluid passages therein adapted to establish fluid communication between said sample chamber and the fluid passages in said core barrel when the latter is in a core sampling position and to prevent said communication when the core barrel is moved along the drill stem, a spring arranged to bias the free end of said core barrel away from the longitudinal axis of said body, and releasable means arranged for latching said barrel with its longitudinal axis parallel with the longitudinal axis of said body including an annulus slidingly arranged on said body and downwardly extending members secured to said annulus arranged to engage said notches on the core barrel.

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