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W. D. MOUNCE

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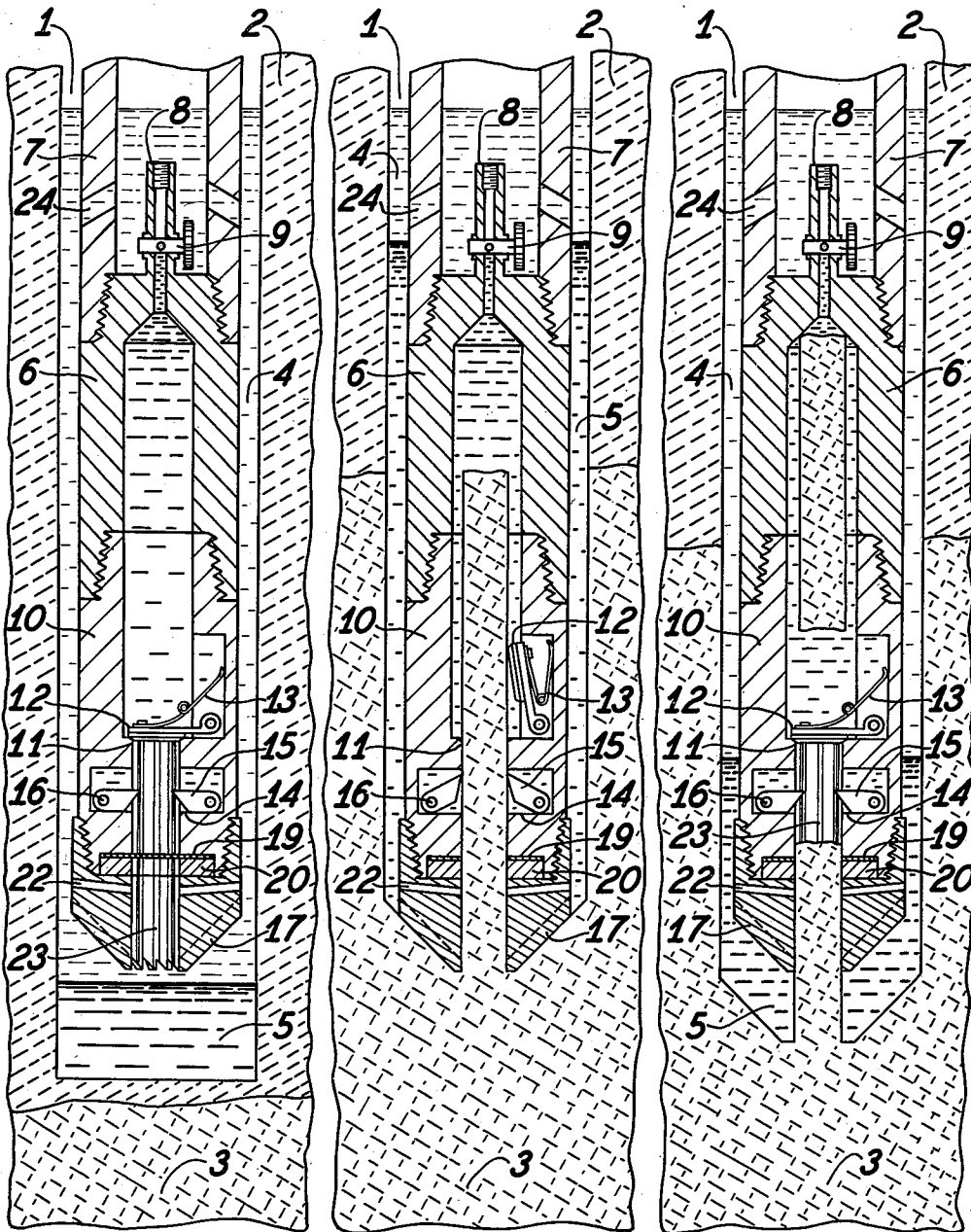


FIG. 1.

FIG. 2.

FIG. 3.

INVENTOR.
Whitman D. Mounce
BY *P. P. Young* ATTORNEY.

UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR CORING

Whitman D. Mounce, Houston, Tex., assignor to
Standard Oil Development Company, a corporation of Delaware

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The present invention is directed to a method for taking samples in the form of cores from bore holes and to an apparatus suitable for use in said method.

The principal object of the present invention is the provision of a method and means for recovery of a sample from a bore hole free from contamination with drilling fluid.

An additional object of the present invention is the provision of the method and means for the cutting of an uncontaminated core in a bore hole and the delivery of said core to the surface, while maintaining it under the pressure of the formation from which it was cut.

Further objects and advantages will appear from the following description of the accompanying drawing in which

Fig. 1 is a vertical section through a coring device according to the present invention in a bore hole with the parts in a position which they assume before coring is begun;

Fig. 2 is a similar view with the parts in the position they assume during the coring operation, and

Fig. 3 is a similar view showing the position of the parts at the completion of the coring operation.

Referring to the drawing in detail, numeral 1 designates a bore hole which has been drilled into the earth through earth section 2 to a point just short of formation 3 which is to be sampled. This hole is filled with drilling fluid 4. In the practice of the present invention, a quantity 5 of mercury or other water-insoluble liquid, having a specific gravity heavier than that of the drilling fluid, is deposited at the bottom of the bore hole, and a coring device is introduced into the bore hole. In order to secure the full advantages of the present invention, the coring device should be one which is sealed off from the liquid in the bore hole until the coring operation is begun. At this point the mercury or other heavy liquid constitutes a seal between the formation being drilled and the bore hole fluid. For best results, the coring device should be provided with means for sealing the recovered core in a sample chamber after the coring operation is completed and before the open end of the coring device is lifted out of the mercury.

In Fig. 1 is shown a core barrel 6 carried by a drill stem 7. The barrel 6 has at its upper end a threaded inlet nipple in which is arranged a valve 9. To the lower end of barrel 6 is secured a cylinder 10 having a shoulder 11 intermediate its ends. Mounted on the upper side

of this shoulder is a flap valve 12 which is normally held in sealing position by a spring 13. Below and spaced from this shoulder is a second shoulder 14, on the upper angular face of which are pivoted pawls 15 which are wedge-like in shape and are mounted on stub shafts 16 and may have their pointed ends spring-pressed toward the axis of the center of the cylinder 10.

The cylinder 10 carries a cutter head 17 which is provided at its lower edge with serrations 18 suitably shaped and sharpened to serve as core cutters. Between the cutter head 17 and the lower end of cylinder 10 is carried a disk 19 held in place by a washer 20 which is adapted to seat in a suitable recess in the end of cylinder 10. This disk is made of a soft metal or other material capable of being ruptured by the upward movement of a core through the central passage 21 of the cutter head. Immediately below the disk are radial passages 22, the purpose of which will be hereinafter explained. Also the central passage of the cutting head, as well as the lower end of cylinder 10, is provided with longitudinal grooves 23, spaced from each other around its periphery, for the purpose hereinafter specified.

In the use of the coring device described above, valve 9 is opened at the surface and the interior of the core barrel including cylinder 10 is filled with mercury or other heavy liquid as previously defined. This serves to prevent the rupture of the disk 19 by the bore hole fluid pressure before the formation to be sampled is reached. The assembly is then lowered into the well until the cutter head reaches the mercury at the bottom. As the assembly is further lowered, the mercury forces any drilling fluid in the central passage of the cutter head out through the radial passages 22, which, in practice, may be so arranged that no drilling mud will remain in the central passage. The coring operation is then begun.

As the core begins to move up through the central passage of the cutting head, it breaks the disk 20, moves the pawls 15 into the position shown in Fig. 2 and opens the valve 12 to the position shown in Fig. 2. As the core moves upwardly into the barrel it displaces mercury from the latter, although the pressure relationships will be such that the undisplaced mercury will remain in the barrel. When a core of the desired length is cut, the assembly is jerked upwardly. This causes the pawls 15 to penetrate the core and pinch it off. When this is accomplished, the difference in density between the core and the mercury in the barrel causes the former to rise to the top of barrel 6, disengaging flap valve 12

and allowing it to be closed by spring 13. Since the greatest pressure in the bore hole will be at its bottom, and since, when flap valve 12 was closed, the interior of the barrel was in pressure equilibrium with the bore hole, the flap valve will be held securely in closed position by the pressure inside the barrel during the upward movement of the assembly to the surface.

When the assembly reaches the surface, the barrel 6 is detached from the drill stem and the nipple 8 is secured to an analytical apparatus. The valve 9 is then opened so that any volatile constituents which were liquid at the formation pressure, but would vaporize upon a reduction of pressure, will leave the core and pass into the analytical apparatus. When the volatile constituents have been recovered, the cylinder 10 can be severed from the barrel 6 and the core recovered and analyzed.

It will be understood that the above described apparatus is not necessary to the performance of the method of the present invention. Other pressure core barrels, such as that described in co-pending application Ser. No. 242,211, filed November 25, 1938, entitled Pressure coring device, can also be employed. Furthermore, the coring device need not be of the pressure type, but can be any of the conventional coring devices which, when used according to the method of the present invention, will deliver a much less contaminated core than when used in the conventional manner. On the other hand, the coring device described above cannot fulfill its function of delivering a core under the pressure of the formation from which it was obtained, unless it is used in conjunction with a liquid of heavy specific gravity in accordance with the method of the present invention.

In the practice of the present invention it is advantageous to deposit the mercury or other heavy fluid in the bore hole, before the ordinary drill bit is removed, and to drill a few feet into the surface without mud circulation. The object of this step is to remove that portion of the formation which might be contaminated by the drilling fluid. Then the drill stem is removed and the conventional drill head replaced by the coring drill head described above.

It may also be desirable to circulate drilling fluid in the bore hole during the coring operation and, for this purpose, ports 24 can be provided in the drill stem just above the core barrel.

It will be understood that the specific embodiment described above is merely illustrative of the present invention. Changes in size and shape and arrangement of parts are contemplated within the scope of this invention.

The nature and objects of the present invention having been thus described and illustrated, what is claimed as new and useful and is desired to be secured by Letters Patent is:

1. A method for securing a core at the bottom of a bore hole containing a drilling fluid which comprises introducing into the hole a liquid immiscible with the drilling fluid and of greater specific gravity than the drilling fluid, whereby a layer of said liquid is formed at the bottom of the bore hole, introducing a coring device into the bore hole, conducting the coring operation beneath the layer of introduced liquid, and withdrawing the core produced.

2. A method for securing a core at the bottom of a bore hole containing a drilling fluid which comprises introducing into said bore hole a

liquid heavier than the drilling fluid and immiscible therewith, whereby a layer of said liquid is deposited at the bottom of said bore hole, introducing into said bore hole a coring device carrying a core barrel sealed from the liquid in the bore hole, maintaining said chamber in sealed condition until the coring operation is begun beneath said layer of heavy liquid, completing the coring operation beneath said layer of heavy liquid, sealing said chamber while the open end of said coring device is still beneath said heavy liquid, and returning said chamber to the surface.

3. A coring device comprising a core barrel adapted to be secured to a drill stem, a cutter head carried by said barrel having a central passage adapted to receive a core, a valve between said central passage and the interior of the core barrel adapted to be opened by the movement of said core into said barrel, means for cutting off a desired length of said core from the formation, means for raising the cut-off portion of said core into said barrel, thereby disengaging it from said valve, and means for normally holding said valve in closed position.

4. A coring device comprising a core barrel adapted to be secured to the end of a drill stem, means for sealing the upper end of said barrel from the interior of said drill stem, a drilling head secured to said barrel having a central passage for the receipt of a core, a frangible disk across said passage normally sealing the lower end of said barrel and a valve arranged in said barrel above said disk adapted to remain normally in closed position and to be opened by the movement of a core upwardly through said passage.

5. A coring device comprising a core barrel adapted to be secured to the end of a drill stem, means for sealing the upper end of said barrel from the interior of said drill stem, a drilling head secured to the lower end of said barrel having a central passage for the receipt of a core, a frangible disk arranged across said passage to normally seal the lower end of said barrel, a valve arranged in said barrel above said disk adapted to normally remain in closed position to seal off the lower end of said barrel and to be opened by the movement of a core upwardly into said barrel, and means between said valve and said disk for cutting off a core.

6. A coring device comprising a core barrel adapted to be secured to the end of a drill stem, a nipple on the upper end of said barrel, a valve in said nipple, a drilling head carried by the lower end of said barrel having a central passage for the receipt of a core, a frangible disk arranged across said passage normally sealing the lower end of said barrel, a flap valve arranged in said barrel above said disk adapted to seal the lower end of said barrel, spring means for normally holding said valve in closed position, and cutters arranged in said barrel between said flap valve and said disk for severing a core from the formation being tested.

7. A coring device comprising a core barrel adapted to be secured to the end of a drill stem, means for sealing the upper end of said barrel from the interior of said drill stem, a drilling head secured to said barrel having a central passage for the receipt of a core and a frangible disk arranged across said passage for sealing the lower end of said barrel, said disk being arranged to be broken by the core.

8. A coring device comprising a core barrel adapted to be secured to the end of a drill stem, means for sealing the upper end of said barrel from the interior of said drill stem, a drilling head secured to said barrel having a central passage for the receipt of a core, a frangible disk across said passage normally sealing the lower end of said barrel, a valve arranged in said barrel above said disk adapted to remain normally in closed position and to be opened by the movement of a core upwardly through passage, and means for raising a cut-off portion of a core into said barrel, thereby disengaging it from said valve.

9. A coring device comprising a core barrel adapted to be secured to the end of a drill stem, a drilling head secured to said barrel having a central passage for the receipt of a core, means normally sealing in a fluid-tight manner the interior of said core barrel from said passage and adapted to be rendered inoperative as a seal by the core after the coring operation has begun and separate means for resealing said barrel from said passage in a fluid-tight manner after the completion of the coring operation.

WHITMAN D. MOUNCE.