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APPARATUS FOR SAMPLING THE ROCK IN BORE HOLES

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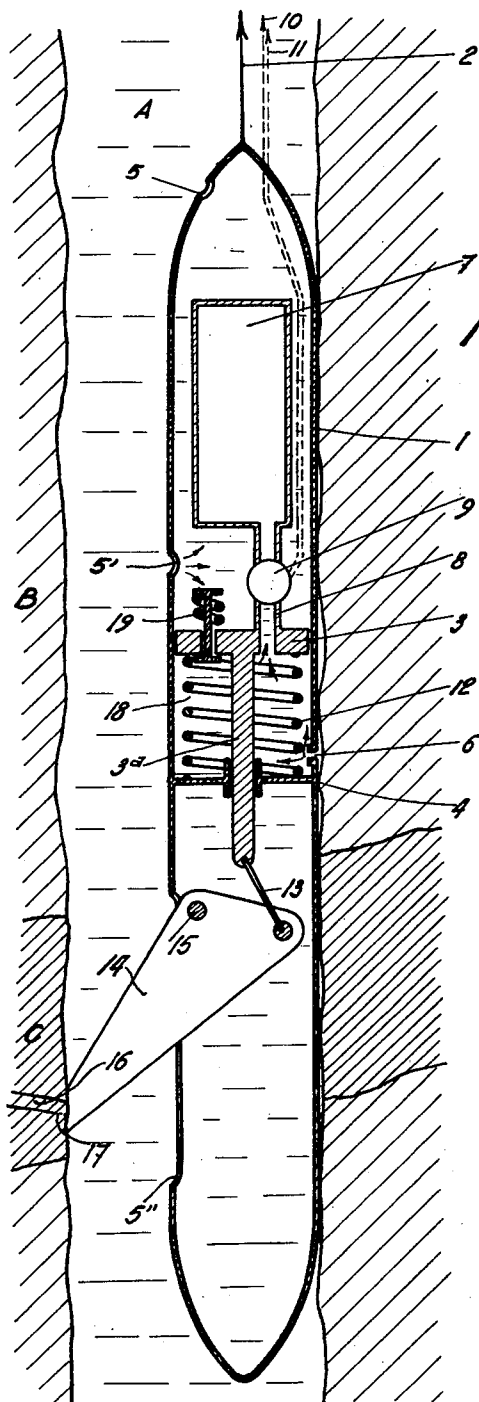


Fig. 1

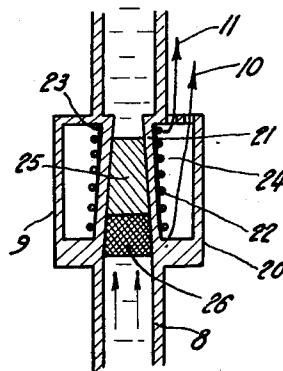


Fig. 2

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APPARATUS FOR SAMPLING THE ROCK IN
BORE HOLES

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4 Claims. (Cl. 255—1)

In the course of the drilling of a bore hole, it is usually necessary to take a certain number of samples at carefully checked depths so as to obtain a picture of the geological column encountered. In present practice, with the rotary process, these sample cores are removed from the bottom of the hole by means of a tubular tool fixed at the lower end of the drilling pipes. This mechanical practice has the disadvantage of involving considerable time and expense, since it makes it necessary to pull up and down the whole set of pipes for each sampling operation.

With the development of the electrical methods of well surveying described in particular in U. S. Patents No. 1,819,923 and No. 1,913,293, and which provide means for studying the formations traversed by a bore hole all along its uncased part, there has been a tendency to do away, to a great extent, with mechanical coring and to rely principally on electrical diagrams for a thorough study of the formations encountered.

In certain particular cases, it is nevertheless of interest to have an opportunity of taking samples from the lateral wall of a bore hole which has been completed and not yet been cased. This will be especially the case when the electrical diagrams put in evidence certain strata, the further investigation of which appears desirable.

I already described an arrangement filling this purpose in my pending application Ser No. 710,193, filed February 7th, 1934.

The object of the present invention is to offer another type of arrangement for taking samples from the lateral wall of a bore hole, which is also lowered into the hole by means of a cable comprising one or more insulated electric conductors. This arrangement characterized by the fact that the force necessary to drive the sampling tool into the rock is furnished by a piston, one side of which is subjected to the hydrostatic pressure of the mud filling the bore hole at the depth in question, while the other one is subject only to the pressure existing in a tight container originally filled with air or gas at or below atmospheric pressure. The communication of one or other side of the piston with a space at the above mentioned pressure is accomplished by means of a cock or other device of the like electrically controlled from the surface of the ground.

The accompanying drawing shows by way of example an embodiment of the subject matter of my invention.

Figure 1 shows a vertical cross-section of the sampling apparatus,

Figure 2 shows likewise a vertical cross-section of the sampling apparatus in action.

In Figure 1, A is the bore hole filled with water or drilling fluid at a pressure which, in practice, varies according to the depth and to the density of the fluid employed, namely, from ten or twenty to several hundred kilograms per cm²; B is the ground in which the bore hole is drilled and C the bed from which the sample shall be taken.

The sampling arrangement comprises a long cylinder 1, which constitutes the frame of the apparatus. This frame, pointed at both ends, is attached to a cable 2. In the central part of the cylinder slides a movable piston 3, the rod 3a of which passes through an intermediate, fixed, partition 4 provided with a tight joint. The outside wall of the cylinder is provided with large openings 5, 5', 5'', offering free access to the water filling the hole. Just above the intermediate partition 4 and below the movable piston 3, the outside wall of the cylinder is provided with a very small hole 6 through which the drilling fluid of the hole can flow, but only at a very slow rate.

On the piston 3 is fixed a tight chamber 7 filled with air at or below atmospheric pressure. The connection between the chamber 7 and the piston 3 is realized by a wide tube comprising a special stopper, the sudden release of which is electrically operated from the surface by means of the insulated conductors 10 and 11.

Between the piston 3 and the partition 4 is a spring 12, the function of which will be explained hereinafter.

The piston rod 3a is connected by means of a rod 13 to a lever 14, pivoted on an axis 15 so that it can swing out of the cylinder 1 through the aperture 5''. This lever carries at its lower end the coring or sampling tool 16 which may be, for example, constituted by a steel tube with its end slightly sharpened to a cutting edge. The coring tool 16 is provided at its end with a small vent 17 through which the water filling it may be evacuated when the tool is driven into the ground.

As a consequence of the release of the stopper, a communication is established between the space 18, located between the piston 3 and the partition 4, and the low pressure chamber 7, by means of the connecting tube 8, of comparatively large diameter. At the instant of the release, the water contained in the space 18, water which is subjected to the high pressure existing in the bore hole, rushes violently into the chamber 7, while

the water surrounding the apparatus can only penetrate slowly into the space 18, as a result of the small dimension of the orifice 6. The pressure in the space 18 thus falls to a low value which is of the order of magnitude of the pressure existing in the chamber 7. The piston 3, on whose upper face the hydrostatic pressure of the water filling the bore hole still remains, is rapidly pushed downwards, driving with it in its movement the closed chamber 7. The piston rod 3a moves down and the rod 13 pushes the pivoted lever 14.

This lever which initially was located inside the metallic case of the apparatus 1 comes out of it together with the coring tool 16. The latter penetrates like a punch into the ground by mere pressure.

The downward movement of the piston 3 and consequently the penetration of the coring tool 16 into the ground takes place very quickly as soon as the stopper 9 is released. In its movement the piston 3 also compresses the spring 12. When the downward movement of the piston is finished, the water filling the hole continues to flow into the space 18 through the small orifice 6, and thence fills the chamber 7, or at least part of it until the pressure in this chamber becomes equal to the hydrostatic pressure existing in the bore hole at the depth at which the apparatus is located. At this moment, the pressure being the same on both faces of the piston, the latter is no more subjected to any force due to the pressure of water and the spring 12, compressed in the downward movement of the piston expands and gradually brings back the piston to its initial position and with it the lever 14 and rod 13. The rapidity of return of the piston to its initial position is relatively slow because the orifice 6 is small and the water of the bore hole penetrates only progressively into the space 18.

The apparatus shown in Figure 1 comprises in addition a safety valve 19, provided with a spring which opens as soon as the difference in pressure between the two sides of the piston exceeds a determined value. The purpose of this valve is to limit the force driving the piston downwards when the apparatus is operated at a great depth, under high hydrostatic pressures, so that the lever 14 or the rod 13 might not be damaged under the action of unduly large efforts.

Figure 2 shows an embodiment of the special stopper 9 closing the chamber 7, by which the instrument may be set into action by means of an electric current operated from the surface. On tube 8, a tight metallic box 20 has been fixed. It contains in its centre a hollow cone 21. In it a coil of heating wire 22, insulated from the central cone by a thin sheet of mica 23 has been wound. This wire is insulated from the outer wall of the box by an asbestos filling 24. The terminals of the coil are connected with the surface of the ground by means of the insulated conductors 10 and 11. The hollow cone 21 is stopped by means of a plug of fusible material 25, and complete tightness of the device is further insured by means of a rubber plug 26.

When the apparatus is lowered in a bore hole, the hydrostatic pressure of the drilling fluid of the hole at the depth under consideration is applied on the large base of the rubber plug 26 which is compressed against the fusible plug 25 and thus renders it perfectly tight. If from the surface of the ground an electric current of convenient intensity is sent through the conductors 10 and 11

into the coil 22, the core melts and the hydrostatic pressure pushes through the central hole the remnants of the melting core and the rubber plug. The water under pressure then rushes through this large aperture into the closed chamber 7, putting into action the instrument as described above.

The special stopper could also be constituted in a very different manner. It would be possible, for example, to utilize a valve operated by an electric motor fed from the surface of the ground by means of the cables 10 and 11.

If a sample of a porous bed impregnated with a fluid (water, petroleum or gas) has to be taken, the coring tube may be provided with a sucking arrangement by means of which it will store in a closed receptacle a sample of the fluid contained in the bed. This sucking arrangement may be of the type described in my above referred to co-pending application Serial No. 710,193; i. e. it may consist of a closed receptacle comprising a nozzle provided with a valve which makes it possible for the fluid to be pushed by pressure into the receptacle and to remain imprisoned there while the nozzle is withdrawn from the sand.

What I claim is:

1. A side-wall sample taker adapted to be lowered into bore holes, the necessary power for forcing the sampling tool into the formation being provided by a piston, one side of which is subjected to the hydrostatic pressure of the drilling fluid filling the bore hole at the depth at which the instrument is operated, and the other side being subjected to a lower pressure, the movement of said piston being electrically controlled from the surface.

2. A side-wall sample taker adapted to be lowered into bore holes by means of an insulated cable consisting of one or several electrically insulated conductors, said sampling tool being operated by the pressure of the drilling fluid and comprising: a framework, and mounted thereon a movable coring tool for penetrating the walls of the hole; a piston movable in a cylinder; connecting means between the piston and said coring tool; a closed chamber filled with a fluid or gas at a pressure below the one of the drilling fluid filling the bore hole at the depth at which the sampling tool is operated, said chamber communicating with a space existing in the cylinder on one side of the piston, whilst the other side thereof is subjected to the hydrostatic pressure of the fluid filling the bore hole; a connecting device with a large aperture putting in communication the space on the first above mentioned side of the piston with the aforesaid low-pressure chamber, said connecting device being opened and shut by an electric means operated from the surface.

3. A side-wall sample taker according to claim 2, wherein the said connecting device is being stopped with a fusible plug; and an insulated coil to cause said plug to melt when an electric current is sent through it from the surface.

4. A side-wall sample taker according to claim 2, in combination with a small orifice allowing the drilling fluid to flow slowly into the space on the first above-mentioned side of the piston, thus providing a means for equalizing slowly the pressures on the two sides of the piston after the sampling tool has been operated, and a return spring so located as to return piston and coring tool to their initial positions.

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