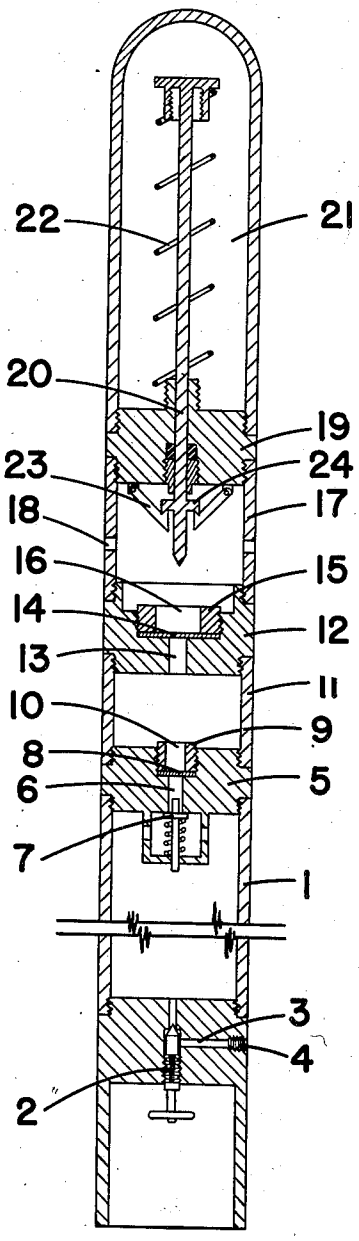
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BOTTOM HOLE SAMPLER

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BOTTOM HOLE SAMPLER

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4 Claims. (Cl. 166—1)

The present invention is directed to a borehole sampling device.

The principal object of the present invention is provision of a borehole sampling device capable of use in conjunction with a drill stem tester for the recovery of a sample of formation fluid under formation pressure.

Another object of the present invention is the provision of a sampler of the type referred to which remains sealed up to a predetermined point in a drill stem test.

An additional object of the present invention is the provision of a device of the type referred to in which the sampling chamber is sealed off by a succession of seals which are broken at successive points in the course of a drill stem test by virtue of the pressure changes which take place in the pressure cycle of a drill stem test.

Further objects and advantages of the present invention will appear from the following detailed description of the accompanying drawing in which the single figure is a vertical section of one embodiment of the present invention.

Referring to the drawing in detail it will be observed that the sampling device is in the form of a cylindrical bomb. This bomb is so constructed as to be placed in the perforated nipple below the packer of a drill stem testing apparatus such as that shown in U. S. Patent 2,189,919. It is to be understood that this sampling device is not to be used in place of the recording pressure gauge shown in this patent but is to be included in the perforated nipple in addition thereto, for which purpose the nipple may be made sufficiently large.

The sampler is made up in a plurality of sections, of which section 1 is the sample receiving chamber. It is provided at its lower end with a needle valve 2, which seals off a passage 3, having a threaded portion 4 adapted to receive a threaded pipe for leading the sample into an analytical apparatus. The upper end of the chamber 1 is provided with a plug 5 having a central passage 6, at the lower end of which is a check valve 7, normally spring-pressed upwardly so as to permit only the entrance of fluid into chamber 1 through passage 6. The upper end of passage 6 is sealed by a disc 8 held in place by bolt 9, having a central opening 10.

Sleeve 11 connects the plug 5 with a second plug 12 having a central passage 13 sealed by a disk 14, held in place by a bushing 15, which also has a central opening 16. Connected to plug 12 is a sleeve 17 provided with perforations 18 in its wall to permit the inflow of fluid.

The sleeve 17 is threaded onto a block 19, which constitutes a stuffing box for a spear 20, which extends upwardly into a sealed chamber 21 and is normally pressed downwardly into the sleeve 17 by a tension spring 22. The spear is held in extended position against the action of the spring by dogs 23, pivotally mounted in the block 19 in such a way as to engage a depending lip on a disk 24, fixed to the lower end of the spear 20.

With the parts in the position shown the sampler is placed in the perforated nipple 16 of the drill stem tester shown in Patent 2,189,919. It will be observed from Figure 3 of said patent that as the sampler is lowered there is a steady increase in pressure. The dogs 23 are so mounted with respect to the disc 24 that as the pressure increases beyond a certain point the spear 20 is moved upwardly and the dogs fall by gravity out of engagement with the disc. This position is maintained until the packer is seated on the rathole and the testing tool valve is opened. This results in a sudden drop in pressure, at which time the spring 22 causes the spear 20 to move downward rapidly, and to rupture the disc 14.

After the testing tool is opened to the formation the pressure builds up again. The disc 8 is so selected that it is ruptured at a pressure less than the maximum pressure to be expected in the formation. When this disc is ruptured fluid from the formations enters. In order to induce the entry of this fluid into the chamber 1, this chamber is evacuated at the surface before the device is introduced into the borehole.

It will be apparent that changes in design and construction may be incorporated into the specific apparatus illustrated without departing from the scope of the present invention. The principal requirement is that the sampling chamber be sealed by a succession of seals which are opened in succession in response to the changes in pressure in the pressure cycle characteristic of a drill stem test.

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 formation-liquid sampler adapted to be used in conjunction with a drill stem testing tool and to be arranged in a borehole below the packer of the drill stem testing tool, comprising a chamber adapted to receive a liquid sample, and a succession of spaced seals for said chamber adapted to be opened in succession from the outermost to the innermost in response to the

changes in pressure which occur during the pressure cycle characteristic of a drill stem test.

2. A formation-liquid sampler adapted for use in conjunction with a drill stem testing tool and to be arranged in a borehole below the packer of the drill stem testing tool, comprising a chamber adapted to receive the liquid sample, two successive spaced discs sealing the entry to said chamber, means adapted to be set into operation upon the drop in pressure resulting from the opening of the drill stem testing tool for rupturing the outermost of said seals, and means for admitting fluid from the formation to the inner seal, said seal being of a strength such that it will rupture under a pressure less than the formation pressure.

3. A sampling device according to claim 2 in which means is provided for sealing the sampling chamber after it comes into equilibrium with the formation pressure.

4. A formation-liquid sampler adapted to be used in conjunction with a drill stem testing tool and to be arranged in a borehole below the packer of the drill stem testing tool, comprising a liquid receiving chamber, an inlet conduit to said chamber, a pair of spaced discs mounted above said chamber in position in said conduit to prevent the flow of fluid to said chamber from the outside of said sampling device, means to admit fluid from the outside to the outer surface of the outer disc, a spear arranged in position to be thrust through said outer disc, a spring adapted to thrust said spear through said disc, a locking device adapted when in locked position to restrain said spear against the action of said spring and adapted to be released upon the application of a pressure greater than the strength of said spring to the lower end of said spear, the inner disc being selected to be ruptured at a pressure below the pressure of the formation to be sampled, and a back-pressure valve arranged in said chamber for sealing it off after it has received a sample of formation liquid.

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