Sept. 16, 1958 M. P. LEBOURG 2,852,081

FLUID SAMPLING APPARATUS

Filed July 15, 1953

FIG.1.

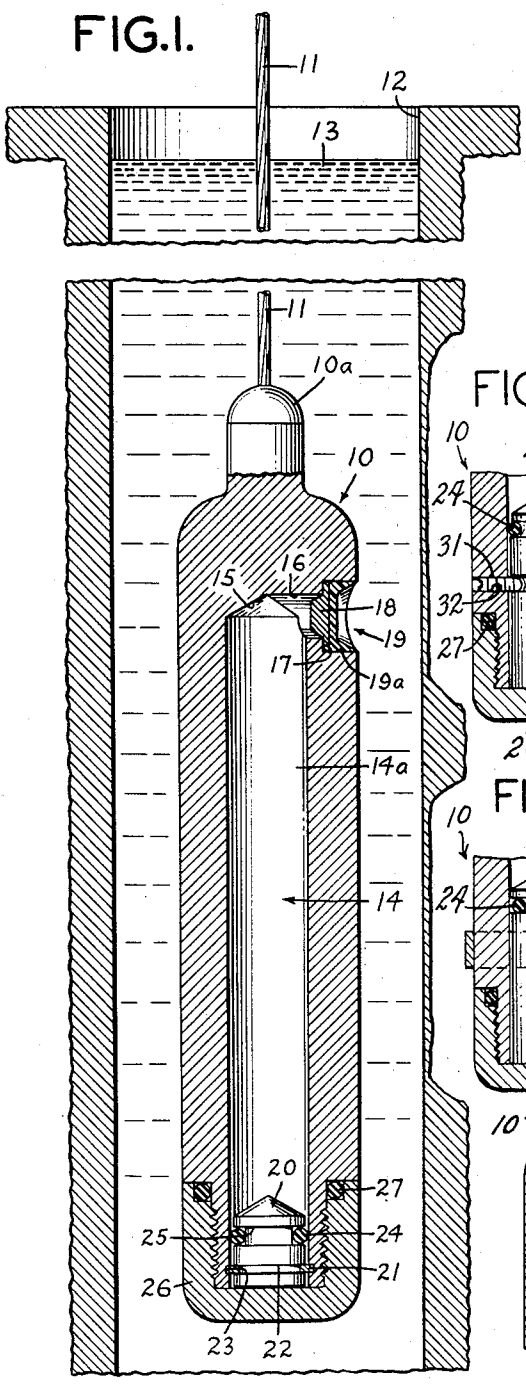


FIG.2.

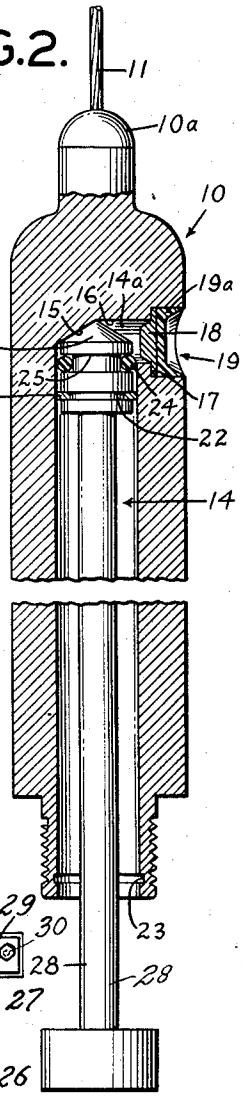
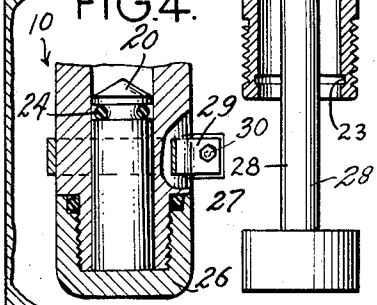


FIG.5

FIG.4.



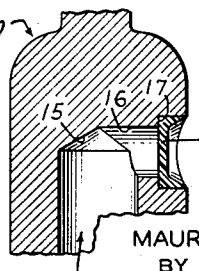


FIG.3.

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FLUID SAMPLING APPARATUS

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Application July 15, 1953, Serial No. 368,103

4 Claims. (Cl. 166—169)

This invention relates to fluid sampling and more particularly pertains to improved apparatus for obtaining a sample of fluid at a predetermined depth in a well.

Procuring a sample of fluid in a well by the simple method of lowering into the well a chamber provided with a valve has not proved satisfactory. Usually, means are provided for selectively opening the chamber to the bore hole fluid at a preselected depth. Since the chamber initially contains air at atmospheric pressure, upon opening of the valve a portion of this air is displaced from the chamber by fluid under a considerably higher pressure than atmospheric. The portion of the air remaining is compressed and dissolved in the sample of fluid. As a result, this compressed air tends to displace the sample from the chamber as it is raised through the upper, low pressure section of the bore hole, and little of the fluid is brought to the surface.

Therefore, it is an object of the present invention to provide novel apparatus for procuring and retrieving a sample of the drilling fluid within a bore hole at a preselected depth therein.

A further object of the invention is to provide an efficient and reliable fluid sampler for use in oil and gas wells which is relatively simple and inexpensive to construct.

A sample of fluid within a bore hole is obtained, according to the present invention, by sealing a chamber to atmospheric pressure, increasing the volume of the chamber to provide a pressure lower than atmospheric pressure therein, and lowering the chamber into the bore hole. In the bore hole, the chamber is opened to the bore hole fluid, thereby aspirating a sample of fluid. After the chamber is removed from the bore hole, the volume thereof is decreased thereby to discharge the fluid sample.

The invention also contemplates the provision of improved fluid sampling means for bore hole use which comprises a sample receiving chamber or cylinder having an end wall. A piston is disposed within the cylinder and is movable in a direction away from the cylinder end wall to a releasably locked position, thereby reducing the pressure within the cylinder below atmospheric pressure. The cylinder is provided with a closed port that is opened after the device is positioned at a selected depth within a bore hole to permit a fluid sample to enter the cylinder. The piston is also movable from its releasably locked position toward the cylinder end wall, so that after the device is taken from the bore hole, the fluid sample may be discharged from the cylinder.

These and further objects and advantages of the invention will be more fully understood when the following description is read in conjunction with the appended drawings in which:

Fig. 1 is a sectional view of fluid sampler means constructed according to the invention disposed in a bore hole drilled into the earth;

Fig. 2 is a sectional view of the sampler shown in Fig. 1 but illustrating an intermediate operating condition;

Fig. 3 shows a modified form of closure means for use in the apparatus of Figs. 1 and 2;

Fig. 4 is a fragmentary section illustrating a modified locking mechanism for the sampler illustrated in Fig. 1; and

Fig. 5 is a fragmentary section showing another modified locking mechanism that may be used in the sampler of Fig. 1.

In Fig. 1 of the drawing, there is shown a typical fluid sampling device **10**, constructed in accordance with the present invention, suspended within a bore hole **12** by a cable **11** secured to a conventional cable connector **10***a*. The bore hole **12** contains a fluid **13**, such as a water base mud, of which a sample is to be procured at a predetermined depth by means of the device **10**. The cable **11** is adapted to be raised and lowered in the bore hole **12** by conventional means (not shown).

The sampling device **10** is of generally cylindrical configuration and is provided with a coaxial sample receiving chamber or cylinder **14** having an upper end wall **15**, but having no lower termination. A port **16** extends from a portion of the cylinder **14** adjacent the end wall **15** to the exterior surface of the device **10** and is normally maintained closed by suitable closure means **19**. To this end, the port **16** may abruptly increase in diameter at an intermediate section thereof to provide a shoulder **17** on which a frangible member or shear plate **18** is adapted to be seated. A seal **19***a* of rubber or other suitable material may cooperate with the shear plate **18** and the enlarged portion of the port **16** to complete the closure means **19**. The shear plate **18** is designed to rupture at a predetermined pressure corresponding to a selected depth of fluid within the well **12**.

A piston **20** is disposed within the cylinder **14** and is movable between a position adjacent the end wall **15**, illustrated in Fig. 2, and a releasably locked position adjacent the lower extremity of the cylinder **14**. The piston may be releasably locked at the latter position by any suitable means such as a resilient, C-shaped locking ring **21** carried in an annular slot **22** formed in the outer wall of the piston **20** and adapted to engage an annular recess **23** formed in the wall of the cylinder **14**. Appropriate means such as a sealing ring **24** disposed in another annular recess **25** in the piston **20** is provided to insure a fluid tight seal between the piston **20** and the wall of the cylinder **14** while permitting the piston to slide in the cylinder **14**.

The lower end of the sampling device **10** is adapted to be closed by a suitable closure **26** which may be threadedly or otherwise secured thereto. Also, means such as a gasket **27** may be suitably disposed between the device **10** and the closure **26** to seal the lower extremity of the cylinder **14** effectively against bore hole pressure.

In order to condition the sample taking device **10** for operation prior to bore hole use, the closure **26** is removed and an operating member **28** is removably affixed to the piston **20**, such as by being threaded into an opening in the lower end of the latter. With the piston **20** in the position shown in Fig. 2, a shear plate **18**, designed to be ruptured at a preselected pressure, is seated on the shoulder **17** and a rubber seal **19** is put into place. Thus, in accordance with the initial step of the method embodying the present invention, the chamber **14** is sealed to atmospheric pressure.

Thereafter, by manually drawing the operating member **28** outwardly relatively to the cylinder **14**, the piston **20** is displaced in a direction from the end wall **15**. This increases that volume of the chamber **14** defined by the end wall **15** and the face of the piston **20** and thereby reduces the pressure within the chamber below atmospheric pressure. When the locking ring **21** engages the

recess 23, the piston is releasably locked in its lowermost position, as shown in Fig. 1, maintaining the reduced pressure in the chamber 14. Thereafter, the operating member 28 is removed, the closure 26 is screwed into place and the sampling device 10 is lowered into the bore hole 12 on the supporting cable 11.

When the depth at which the preselected pressure of drilling mud 13 occurs is reached, the frangible plate 18 is ruptured. The seal 19 thus is either ruptured or displaced, thereby effectively opening the closure means 19 in the port 16 and bore hole fluid 13 at the selected depth is aspirated into the chamber 14.

After the passing of a time interval sufficient for the filling of the sampling chamber 14, the sampling device 10 is raised to the earth's surface by the cable 11 and is removed from the bore hole 12. The closure 26 is removed and the operating member 28 is again affixed to the piston 20. By manually moving the member 28, the piston 20 is displaced towards the end wall 15 of the cylinder 14 to the position shown in Fig. 2. In this manner, the volume of the chamber 14 is effectively decreased and the fluid sample is discharged through the port 16 to suitable container means.

Of course, if it is desired to perform another sampling operation, the remains of the shear plate 18 and the seal 19 are removed and suitably replaced. The just described process steps, according to the present invention, may then be repeated.

Since the chamber 14 is at a pressure lower than atmospheric pressure when it receives a fluid sample, there is very little air to be compressed or dissolved in the received drilling fluid sample. Consequently, although no valve closing means is provided for the chamber 14, the fluid sample is retained as the sampling device 10 traverses the upper, low-pressure section of the bore hole 12.

Furthermore, since the fluid sample is not entrapped under high pressure, it may be readily and safely retrieved merely by displacing the piston 20 towards the end wall 15 of the sample chamber 14.

From an inspection of Figs 1 and 2, it is obvious that the sample taker capable of carrying out the present inventive method does not require a complex piston releasing mechanism that must be operated in the bore hole. Accordingly, the sampler is relatively simple and inexpensive to construct. Moreover, movement of the piston is not required when the sampler is in a bore hole; hence, the sampler operates efficiently and reliably in procuring a sample of drilling mud.

It will be understood that other varieties of closure means for the port 16 may be employed, such as a time operative device, for example, one of the type comprising a sealing member 18*a* for the port 16 that is soluble in the bore hole fluid 13, as shown in Fig. 3. In this embodiment, after exposure to the fluid for a preselected time interval, the seal 18*a* is dissolved and the port 16 is opened to the bore hole fluid.

Further, although one type of releasable lock including the locking ring 21 and the recess 23 has been illustrated for the piston 20, other forms may be employed. For example, a clamp type of lock as shown in Fig. 4 comprising a clamp 29 tightened by a nut and bolt combination 30 may be utilized whereby the wall of the lower end of the device 10 is distorted frictionally to engage the piston 20. Alternatively, a set screw type of lock as shown in Fig. 5 may be employed including a screw 31, threaded into a transverse opening 32 in the wall of the device 10, and received by an annular slot 33 formed in the piston 20.

The sampling apparatus according to the invention may advantageously be combined with the apparatus disclosed in the applicant's copending application Serial No. 363,480, filed June 23, 1953, for "Method and Apparatus for Determining the Resistivity of the Mud in a Bore Hole" to enable the two methods to be practiced simultaneously in a bore hole. To this end, the exploring electrodes used in the system disclosed in the said copending application might be mounted on the sampling device 10 and insulated therefrom, to enable mud resistivity indications to be obtained during a sampling run.

While a particular embodiment of the present invention has been shown and described, it is apparent that changes and modifications may be made without departing from this invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

1. A device for sampling fluid by immersion in the fluid comprising a housing provided with a hollow cylinder therein, means to close one end of the cylinder including means defining a closable port opening into the interior of the cylinder, a piston slidably mounted in the cylinder sealably engaging the inner cylinder wall to form an adjustable volume chamber between one face of the piston and said one end of the cylinder, closure means insertable in said port with the piston adjacent the closed end of the cylinder, the piston thereafter being movable to the other end of the hollow cylinder, means to lock the piston at the other end of the cylinder to provide maximum volume of the adjustable volume chamber with the pressure therein below atmospheric pressure, the closure means being operable in response to immersion of the device in the fluid in accordance with a characteristic of the fluid to permit said fluid to flow through the port into the cylinder.

2. A device for sampling fluid by immersion in the fluid comprising a housing provided with a hollow cylinder therein, means to close one end of the cylinder including means defining a closable port opening into the interior of the cylinder, a piston slidably mounted in the cylinder sealably engaging the inner cylinder wall to form an adjustable volume chamber between one face of the piston and said one end of the cylinder, pressure responsive closure means insertable in said port with the piston adjacent the closed end of the cylinder, the piston thereafter being movable to the other end of the hollow cylinder, means to lock the piston at the other end of the cylinder to provide maximum volume of the adjustable volume chamber with the pressure therein below atmospheric pressure, the closure means being operable when subjected to predetermined pressure conditions in the fluid in which the device is immersed to permit said fluid to flow through the port into the cylinder.

3. A device for sampling fluid by immersion in the fluid comprising a housing provided with a hollow cylinder therein, means to close one end of the cylinder including means defining a closable port opening into the interior of the cylinder, a piston slidably mounted in the cylinder sealably engaging the inner cylinder wall to form an adjustable volume chamber between one face of the piston and said one end of the cylinder, fluid soluble closure means insertable in said port with the piston adjacent the closed end of the cylinder, the piston thereafter being movable to the other end of the hollow cylinder, means to lock the piston at the other end of the cylinder to provide maximum volume of the adjustable volume chamber with the pressure therein below atmospheric pressure, the fluid soluble closure means being formed to dissolve after exposure for a predetermined mit fluid to flow through the port into the cylinder.

4. A device for sampling fluid at a predetermined depth in a borehole comprising a housing provided with a hollow cylinder therein, means to close one end of the cylinder including means defining a closable port opening into the interior of the cylinder, a piston slidably mounted in the cylinder sealably engaging the inner cylinder wall to form an adjustable volume chamber between one face of the piston and said one end of the cylinder, pressure responsive closure means including a frangible

member insertable in said port with the piston adjacent the closed end of the cylinder, the piston thereafter being movable to the other end of the hollow cylinder, means to lock the piston at the other end of the cylinder to provide maximum volume of the adjustable volume chamber with the pressure therein below atmospheric pressure, said frangible member being formed to rupture when subjected to predetermined pressure conditions in the borehole fluid to permit said fluid to flow through the port into the cylinder.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,852,081 September 16, 1958

Maurice P. Lebourg

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 66, for "mit" read -- time to the fluid in which the device is immersed to permit --.

Signed and sealed this 2nd day of December 1958.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents