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R. F. FARRIS
APPARATUS FOR SAMPLING WELLS

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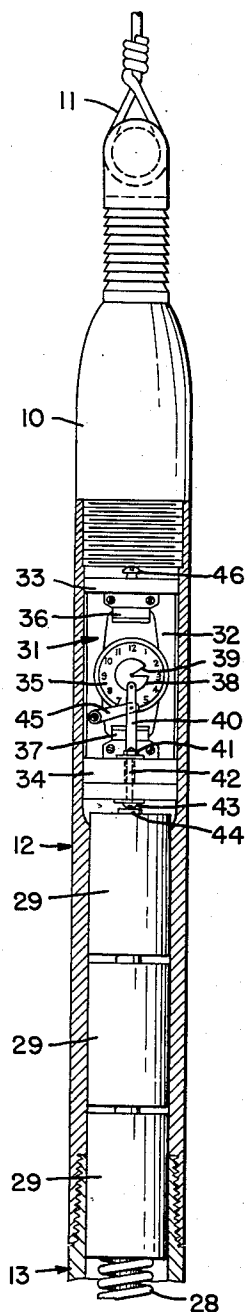


FIG. 1

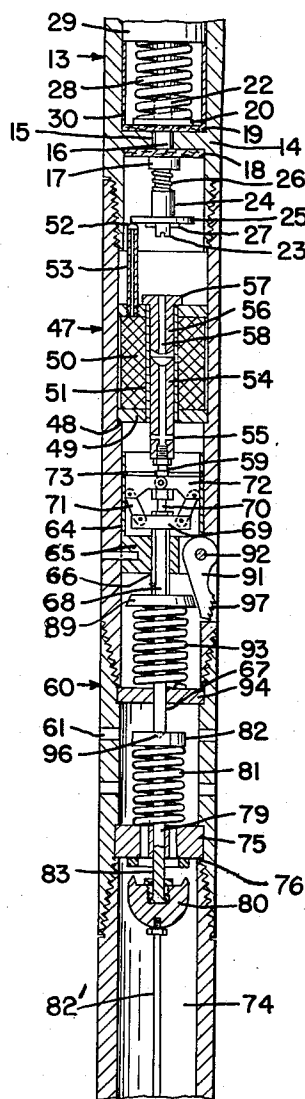


FIG. 2

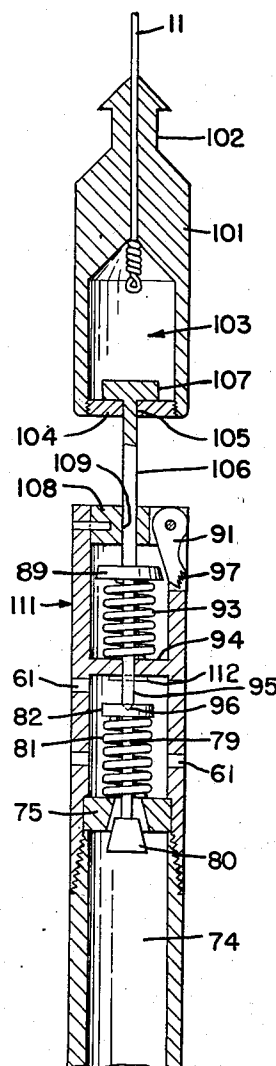


FIG. 3

RILEY F. FARRIS
INVENTOR.

BY *L. C. Goodwin*
ATTORNEY

UNITED STATES PATENT OFFICE

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APPARATUS FOR SAMPLING WELLS

Riley F. Farris, Tulsa, Okla., assignor to Stanolind Oil and Gas Company, Tulsa, Okla., a corporation of Delaware

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This invention relates to the sampling of well fluids and more particularly it relates to an improved apparatus for determining the exact location in a well where a bottom hole sampling chamber is sealed.

Sampling of reservoir fluids is now a well established art. In this art the importance of obtaining a representative sample has been carefully considered; however, I have found that a truly representative sample of the well fluids may occasionally appear to be anomalous for the reason that while the sample may be truly representative of the total stream from which it was obtained, it may not have been obtained in the well at the exact location desired. Bottom hole samplers of the type described in U. S. Patent 2,342,367, that is, the type which employ a chamber having inlet and outlet ports maintained in an open position during the time the sample is lowered into the well and which entrap a sample of the fluid at the instant a frangible member such as a shear pin or the like is destroyed, are commonly used in the art. While samplers of this type are believed to take representative samples of the fluid in the well where the sampler is located at the time the frangible member is destroyed, I have found that the frangible member is not always destroyed at the desired location. For example, I have found that due to heading of the well, i. e., non-uniform flow, the sample chamber may be jarred as it is lowered into a well sufficiently to destroy the frangible member and thus take a sample at the wrong or an undesired location in the well. In any case there is always a question in the operator's mind before the sampler has been removed from a well, particularly a deep well, as to whether a sampler of this type has been jarred sufficiently to destroy the frangible member.

It is therefore an object of this invention to provide an improved well fluid sampler. It is a further object of this invention to provide an improved apparatus for indicating the position of a bottom hole well fluid sampler at the instant a sample is entrapped. A still further object of this invention is to provide an apparatus which is adapted to signal or notify the operator when the valves in a bottom hole fluid sampling device are closed.

Additional objects will become apparent to those skilled in the art as the following description, which is to be read in connection with the annexed drawings, proceeds. In these drawings:

Figure 1 is a vertical section through the upper portion of one embodiment of my invention;

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Figure 2 is a vertical section through a middle portion of the embodiment shown in Figure 1; and

Figure 3 is a vertical section of a preferred embodiment of my invention.

Referring now to Figure 1 of the drawings, headpiece 10 having its upper portion shaped to receive a loop on the end of cable 11, is screwed into the upper portion of tubular section 12 so as to make a pressure-tight seal. Attached to the lower end of section 12 by means of cooperating threads is a coaxial section 13 having the same internal and external diameters and an integral partition wall 14 which is provided with an axial bore 15. Bolt 16 having a smaller diameter than bore 15 but an enlarged portion 17 thereon is inserted through bore 15 but is held out of electrical contact with partition wall 14 and centered in bore 15 by means of insulating discs 18 and 19 on opposite sides of partition wall 14. A small disc 20 of conducting material rests upon disc 19 and the assembly is held in place by means of nut 22. Integral with bolt 16 but extending below enlarged portion 17 is a downwardly-extending shaft 23 having slidably mounted thereon a collar 24 and disc 25 of conducting material. A compression spring 26 urges disc 25 downward along shaft 23 but this downward travel is limited by pin 27 through shaft 23. This construction provides an insulated pressure-tight electrical connection between disc 25 and disc 20.

A compression spring 28 is interposed between disc 20 and a number of single-cell dry batteries 29 connected in series. An insulating sleeve 30 prevents inadvertent contact between spring 28 and section 13. Spring 28 serves two essential functions: first, it provides an electrical connection between disc 20 and batteries 29; and second, it urges batteries 29 and time switch assembly 31 upward against the bottom of headpiece 10 and thus holds them in electrical communication.

Time switch assembly 31 consists essentially of a member 32 having circular enlarged spacers 33 and 34 on its upper and lower ends, respectively, contained within tubular section 12 with a sliding fit. A clock mechanism 35 is mounted, preferably in rubber, on member 32 by means of clamps 36 and 37. A disc sector 38 made of insulating material having a cutout sector 39 is mounted on the clock 35 in place of one of the hands, preferably the minute hand, so that it is slowly rotated thereby. A spring contact member 40, which is mounted upon the upper terminal 41 of an insulated connection 42 through spacer

34 having a lower terminal 43 resting upon positive terminal 44 of the uppermost of batteries 29, bears upon the disc sector 38 in such a way that it is normally held out of contact with ground connection 45 which is mounted on member 32. However, when disc sector 38 has been rotated by clock mechanism 35 until cutout sector 39 registers with spring contact member 40, the latter springs into contact with ground connection 45, thus placing positive battery terminal 44 in electrical contact with member 32, which is grounded to tubular member 12 through spacers 33 and 34 and through capscrew 46 on the upper surface of spacer 33. From the above, it is apparent that the batteries 29 may be placed in electrical contact with tubular member 12 after any desirable predetermined time without the passage of electrical current through clock mechanism 35.

Attached to the lower portion of member 13 by means of cooperating threads and coaxial thereto is tubular member 47, whose lower portion has a somewhat smaller inside diameter than its upper portion, thus forming a shoulder 48, upon which rests a solenoid 49 having windings 50 and an axial bore 51 therethrough. One terminal of solenoid windings 50 is grounded to member 47 and the other terminal 52 extends upwardly through tubular insulator 53 and contacts disc 25. An electrical circuit is thus completed so that solenoid windings 50 are energized when cutout sector 39 of disc sector 33 registers with contact member 40, the circuit running from positive terminal 44 of batteries 29 through insulated connection 42, contact members 40 and 45, member 32, enlarged spacers 33 and 34 and capscrew 46, and tubular members 12, 13, and 47 to solenoid windings 50 and from the other terminal 52 of these windings through disc 25, bolt 16, disc 20 and spring 23 to the negative terminal of batteries 29.

Armature 54 is slidably mounted within bore 51 and has connecting axial and transverse drill holes 55 for the passage of fluid therethrough. Immediately above armature 54 and also slidably mounted within bore 51 is solenoid stop 56, which is supported therein by means of the enlarged head 57 and has an axial hole 58. Armature 54 is adjustably attached at its lower end to armature toggle link 59 by means of threads so that when solenoid windings 50 are not energized and the apparatus is ready for use, as shown, there is a small gap between armature 54 and solenoid stop 56. When solenoid windings 50 are energized by means of the circuit hereinabove described, armature 54 and toggle link 59 are raised a short distance by the magnetic energy of the solenoid 49.

Nipple 60, having a number of holes 61 therethrough, is attached to the lower end of member 47, by means of the internal threads on the nipple. A sleeve 64 is secured within member 47 by means of internal threads, dowel pins or the like. The header 65 of sleeve 64 is formed with an axial opening 66 therethrough for the reception of trigger guide rod 67 which has longitudinal flats 68 formed thereon so as to allow the passage of fluid from the interior of nipple 60 to the interior of member 47, and to aid in preventing sticking of rod 67 in opening 66. Guide rod 67 is attached at its upper end to trigger support member 69 which bears toggle support screw 70 and two oppositely placed links 71 attached at their upper ends to the lower outer portions of two trigger sear links 72 by means of pins. Trigger sear links 72 are both pivoted at

the lower end of armature toggle link 59 and are shaped so that when in cocked position, as shown, their upper outer portions engage retaining shoulder 73, which is preferably a strand of wire or similar material placed in an appropriate groove within sleeve 64 so that it may be easily replaced in the field. This arrangement is such that only a small amount of energy exerted to raise armature 54 and armature toggle link 59 will allow trigger sear links 72 to pass over retaining shoulder 73. The sensitivity of this trigger assembly can be varied by threading toggle support screw 70 in or out. The lower toggle support screw 70 is, and therefore the inner portions of sear links 72, the more stable the trigger assembly is to shock and also the more pull by armature 54 is required to release it.

Sample chamber 74 is connected to the lower end of nipple 60 in such a way that outlet port member 75 is retained in position by shoulder 76 on the end of the chamber wall.

Outlet valve stem 79 carrying outlet valve 80 is slidably supported within member 75. A valve spring 81 which bears on member 75 bears upon spring seat 82 on the upper end of upper valve stem 79 to close valve 80. In some cases it is desirable, as indicated in U. S. Patent 2,161,557, to employ both an upper and a lower valve on the sample chamber. When a lower valve is employed, it is initially cocked open as the sample chamber is lowered into the well and is released by a trigger rod 82' actuated by the upper valve when the sample is trapped in the chamber. A swivel joint 83 is provided between the valve stem 79 and valve 80 by which the latter is kept in alignment.

A cam 89 mounted on trigger guide rod 67 is adapted to contact the inner tapered edge of arms 91 of which only one is shown. These arms which rotate about pins 92 are preferably yieldably supported on the header 67 and tend to remain in the contracted position shown. A second compression spring 93 tends to urge trigger guide rod 67 upwardly. This spring may, for example, bear against cam 89 at the upper end and against the head 94 at the lower end. An extension 95 of trigger guide rod 67 is provided at its lower end with a conical seat 96 which is adapted to fit into a corresponding depression in spring seat 82.

In operating this sampling chamber to obtain a sample of the fluid in a deep well, headpiece 10 and time switch assembly 31 are removed from tubular section 12 and clock mechanism 35 is set so that contact will be made by the members 40 and 45 at a predetermined time sufficient to allow the sampler to be lowered into a well to the depth at which it is desired to take a sample. Time switch assembly 31 and headpiece 10 are reassembled in their proper positions. The sampling device is then lowered into the well on the cable 11. During the lowering operation, the fluid enters the sample chamber 74 through a valve at the bottom (not shown), flows through the chamber and out through the outlet port member 75 and nipple 60 and holes 61. When the level at which the sample is to be taken is reached, the sampling device is raised and rapidly lowered several times to purge sample chamber 74 of well fluid received therein during the lowering of the sampling device so that a representative sample of the well fluid at the desired location may be obtained.

When the predetermined time for taking a sample has arrived, time switch assembly 31 has

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progressed to a position such that the cutout sector 39 of disc sector 38 allows contact to be made automatically by the members 40 and 45; thus, energizing solenoid windings 50 and raising armature 54 a short distance as above described. This movement raises armature toggle link 59 and allows trigger sear links 72 to pass over retaining shoulder 73 so that trigger guide rod 67 is allowed to rise by the action of springs 81 and 93. As trigger guide rod 67 rises, cam 89 also rises, striking the inner tapered surface of arm 91 forcing serrated shoes 97 outwardly against the tubing (not shown). Valve stem 79 being released by the upward movement of trigger guide rod 67 and extension 95 is urged upward by valve spring 81 causing the outlet valve 80 to close against valve seat 85. Simultaneously, as is well known in the art, the upward movement of the valve may be adapted to lock the inlet port in a closed position. Serrated shoes 97 are constructed so that in an extended position they tend to grip the tubing and prevent the sampler from being lowered in the tubing. The sampler may, however, be lifted in the tubing by cable 11 since the serrations do not grip the tubing when moved in that direction. Thus it will be apparent that when and only when the valves on the sampling device are closed, the arms 91 and shoes 97 are extended, preventing further lowering of the sampling device in the well. Accordingly, as a check on the closing of the valves, the operator merely releases the cable 11 to determine whether the arms 91 will support the sampling device in the tubing. If the arms are extended, the device is supported in the tubing, the weight of the sampling device is off of cable 11 and the operator is assured that the sampler valves are closed and that a representative sample of the well fluids have been obtained at the desired location in the well. Obviously, he can be assured that the sample was not obtained at a higher point in the well during the time the sampler was being lowered into the well since the extension of arms 91 prevent further lowering of the sampler after the sampler valves are closed. If, upon lowering cable 11 by a distance greater than one tubing joint, the tension in cable 11 is not reduced due to arms 91 catching in the annular space between the tubing joints, the operator is advised that the sampler valves have not been closed and therefore additional time may be allowed to permit the disc sector 38 to rotate further so that the cutout section 39 progresses to member 40. When the operator is assured that a representative sample has been obtained at the desired location, the sampler can be withdrawn from the well by reeling in cable 11.

Referring now to a preferred embodiment of my invention shown in Figure 3, a jar 101 having a fishing neck 102 is attached to cable 11.

This jar is provided with a recess 103 which is closed at its lower end with a hammer 104. This hammer has a central axial bore 105 through which a shaft 106 extends. Shaft 106 has at its upper end an anvil 107 and at its lower end, cam 89. This shaft also extends through a head 108 which has a central axial bore 109. Head 108 is connected to cylinder 111 at the upper end. Cam 89, compression spring 93, and arms 91 are located and operate in cylinder 111. Extension 95 of shaft 106 extends through head 94 and is provided at the lower end with a conical seat 96. This seat fits into a corresponding depression in spring seat 82 and is adapted to hold valve stem 79 down against the action

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of valve spring 81. Valve stem 79 is provided at its lower end with a valve 80. Valve spring 81 rests at its lower end upon member 75 which is as described above a head in sample chamber 74. Holes 61 are provided in cylinder 111 to permit fluid escaping through member 75 to pass back into the well. Valve 80 is maintained in an open position by shear pin 112 passing through a hole in extension 95. This shear pin is placed in the extension when shaft 106 is depressed and valve 80 is in an open position, i. e., when the springs 81 and 93 are compressed.

The operation of this embodiment of my sampling device is not substantially different from the operation of the previously-described embodiment. However, a brief description of the operation will be given. At the surface, before the sampling device is lowered into the well, springs 81 and 93 are compressed by applying a force on the end of shaft 106. Shear pin 112 is then inserted in extension 95 of shaft 106 through holes 61. Hammer 104 may be removed from jar 101 to compress springs 81 and 93; however, the invention is not so limited inasmuch as shaft 106 may be forced down with jar 101 in position. After the shear pin is in position and jar 101 assembled, the apparatus is lowered into the well. Should the shear pin 112 be destroyed during the time this bottom hole fluid sampler is being lowered into the well, valve 80 and cam 89 will be forced upwardly by valve springs 81 and compression springs 93 respectively, and a sample of the well fluids will be obtained at that elevation in the well. The operator will, however, be immediately advised of the closing of the sample chamber since cam 89 will force arm 91 outwardly into the annular groove at the end of the first tubing joint. In such instance the apparatus can be withdrawn from the well and a new shear pin 112 inserted. Provided this pin is not sheared as the apparatus is lowered into the well, when the elevation is reached at which a sample of the well fluid is desired, the pin may be sheared by the operator. Due to the relatively greater mass of the sampling chamber than the jar, shear pin 112 may be destroyed by lowering and sharply raising cable 11. As cable 11 is lowered, jar 101 is lowered on shaft 106, then as cable 11 is raised sharply, hammer 104 strikes anvil 107 tending to destroy shear pin 112.

The operator, prior to my invention, could never determine whether shear pin 112 had been destroyed by this manipulation. In accordance with this invention, however, after the cable 11 has been lowered and raised sharply to destroy shear pin 112, cable 11 is preferably raised about the length of one tubing joint and then lowered slowly. If shear pin 112 has been destroyed, arms 91 will be automatically forced into the annular groove at the end of the first tubing joint and a decrease in the tension in cable 11 will be noted at the surface; thus, the operator will be advised that valve 80 is closed and that a sample of the well fluid at the predetermined depth is trapped in sample chamber 74. On the other hand, if the apparatus can be lowered for a distance greater than the length of a tubing joint, the operator is advised that shear pin 112 has not been destroyed and that a fluid sample at this particular location in the well has not been secured. Accordingly, further jarring is continued until it is determined, according to the above procedure, that shear pin 112 has been destroyed and that valve 80 has been closed.

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Cam 89 and arms 91 are so constructed that the bottom hole fluid sampler can be withdrawn from the well even after shear pin 112 has been destroyed and arms 91 have been distended. At the surface the representative sample can be removed from the sample chamber 74 as is well known in the art.

While I have thus shown a limited number of alternative means for indicating at the surface the exact depth at which a sample of well fluids is obtained in a bottom hole sampling device, numerous other embodiments will be obvious to those skilled in the art without departing from the spirit of this invention. For example, it is contemplated that while in the embodiments shown, the signalling of the closing of the sampling chamber is accomplished via an uninsulated conductor, an insulated conductor could be employed to transmit electric signals to the surface as an indication of the time and/or location of the apparatus in a well when the sample chamber is closed and the sample entrapped. This invention is therefore not to be construed to be limited to the detailed description of the apparatus shown in the drawing since the drawings and description are presented only for illustrative purposes. The invention is instead limited only by the appended claims.

I claim:

1. An apparatus for sampling fluids in a well including an elongated sample chamber supported by a cable from the surface, a valve at each end of said chamber, a valve rod on each valve, resilient means urging the valves closed, arms rotatably mounted on said chamber and expandable to a diameter larger than said chamber to contact the well walls, a supporting rod for said chamber, a cam on said rod, a frangible member in said supporting rod for holding said valves open and a jar connected to said supporting rod for rupturing said frangible member, said arms being expanded by said cam and said valves being closed when said frangible member is ruptured, whereby further lowering of said chamber in said well is prevented after said valve means is closed as an indication at the surface that said sample is entrapped in said chamber.

2. An apparatus for sampling fluids in a well equipped with a pipe string including a sample chamber, valve means in said chamber for entrapping a sample of fluid within said chamber, and a brake on said chamber responsive to the closing of said valve means for engaging said pipe string to position said chamber in said well.

3. An apparatus for sampling well fluids in a well equipped with a pipe string including a sampling chamber, valve means in said chamber, means to actuate said valve means to entrap a quantity of well fluids in said chamber, and a brake on said chamber actuated upon the closing of said valve means for gripping said pipe string at the time of entrapping said sample.

4. An apparatus for sampling fluids in a well including a sample chamber, inlet and outlet

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valves on said chamber, means to hold at least one of said valves in an open position as said chamber is lowered into a well, means to close said valves and entrap a sample of said well fluids in said chamber when said chamber is in said well, expansible arms rotatably mounted on said chamber, a cam actuated by said means to close said valves and adapted to expand said arms when said valves are closed whereby lowering of said chamber in said well is prevented and the position of said sample chamber when said sample is entrapped in said chamber can be determined.

5. An apparatus for sampling fluids in a well equipped with a pipe string including a sample chamber, valve means on said chamber, frangible means for holding said valve means in an open position as said chamber is lowered into a well, means to destroy said frangible means within said well to close said valve means and entrap a sample of said fluids in said chamber, expansible arms rotatably mounted on said chamber, and a cam for expanding said arms against said pipe string when said frangible means is destroyed whereby further lowering of said chamber in said well is prevented and the position of said sample chamber when said sample is entrapped in said chamber can be determined.

6. An apparatus for sampling fluids in a well equipped with a tubing including a sample chamber having at least one opening therein, closure means for said opening to entrap a sample of said fluids in said chamber, a shear pin for holding said closure means in an open position as said chamber is lowered into a well, jar means coupled to said chamber to destroy said shear pin within said well, expansible arms rotatably mounted on said chamber, a cam movable with said closure means and a compression spring urging said cam against said arms and expanding said arms against said tubing when said shear pin is destroyed whereby further lowering of said chamber in said well is prevented after said closure means is closed as an indication at the surface that said sample is entrapped in said chamber.

RILEY F. FARRIS.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,670,964	Hay et al.	May 22, 1928
1,821,426	Dumm et al.	Sept. 1, 1931
2,113,856	Parks	Apr. 12, 1938
2,161,557	Clark	June 6, 1939
2,209,627	Miller	July 30, 1940
2,249,815	Ennis	July 22, 1941
2,313,176	Shelby	Mar. 9, 1943
2,342,367	Pryor	Feb. 22, 1944
2,407,991	McCullough	Sept. 24, 1946

FOREIGN PATENTS

Number	Country	Date
352,600	Germany	May 3, 1922