Feb. 12, 1952 C. B. CARUTHERS 2,585,369

SIDE-WALL SAMPLER

Filed Nov. 20, 1946

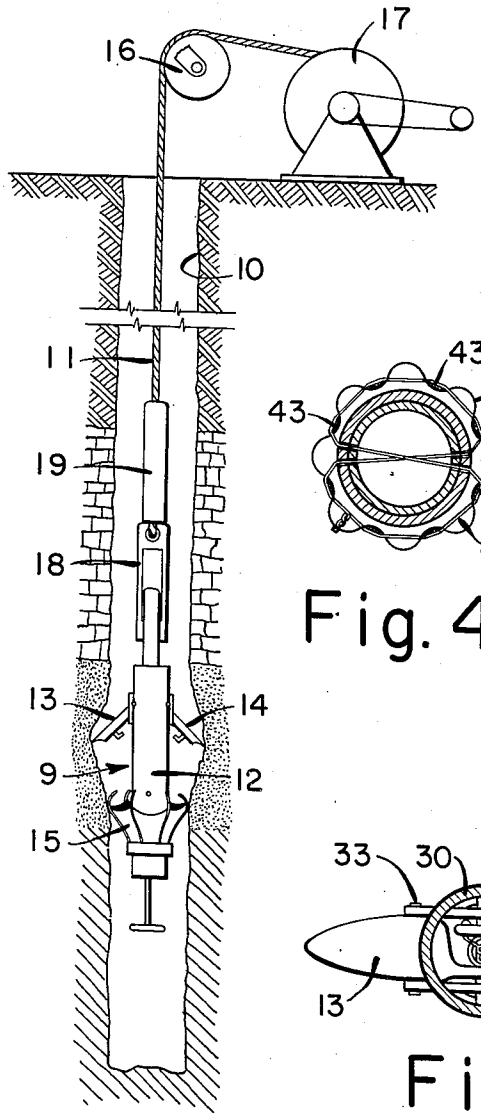


Fig. 1

Fig. 4

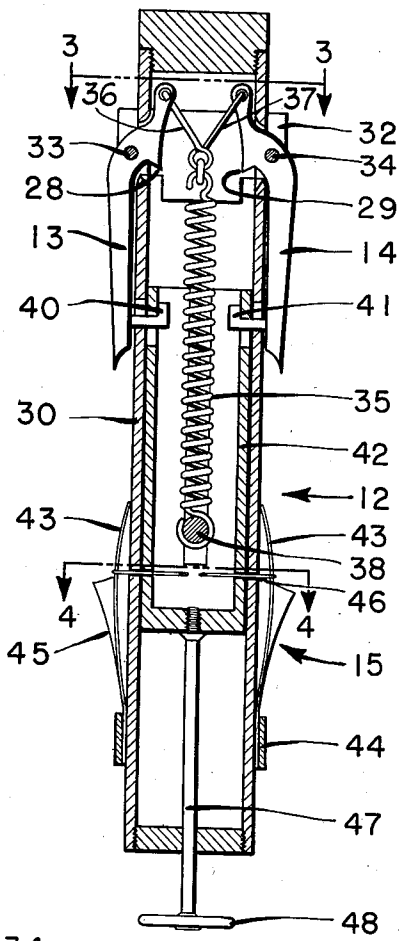


Fig. 2

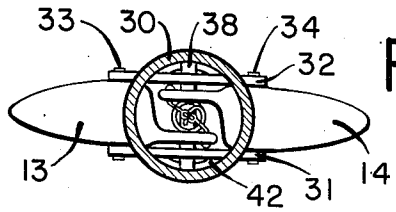


Fig. 3

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Patented Feb. 12, 1952

2,585,369

UNITED STATES PATENT OFFICE

2,585,369

SIDE-WALL SAMPLER

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Application November 20, 1946, Serial No. 710,957

5 Claims. (Cl. 255—1.4)

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This invention relates to sampling well formations and is directed particularly to the recovery of samples of formation exposed in wells, for example, those below the casing in oil and gas wells, regarding which additional information is needed at small expense as a guide for future well operations such as the initiation of a secondary-recovery project. As will be apparent, the invention is applicable also to the sampling of formations in newly drilled oil and gas wells and in test or core holes of small diameter drilled primarily for geological information.

Several methods of obtaining samples of earth formations in wells have been successfully employed, probably the most common being the recovery of drill cuttings which are brought to the surface either by a bailer or by the circulating mud fluid. This sampling method does not ordinarily provide large enough pieces of the formations for reliable testing of porosity, permeability, fluid saturation, and the like by conventional laboratory equipment, and there is frequently some doubt as to the exact depth from which the cuttings are recovered.

During the process of drilling, samples of larger size than cuttings very often are recovered by core-drilling methods. These samples are generally of satisfactory size for laboratory test purposes, and there is seldom serious uncertainty as to the depth from which they are taken. However, as the drilling speed is ordinarily slowed down and special equipment is run into the hole to obtain these cores, which steps add considerably to the expense of drilling, only selected portions of the hole are usually cored, and sometimes only a fraction of the cores cut are recovered. Therefore, it not infrequently happens that samples are desired of formations in other portions of the hole than the cored sections, or of formations which are too soft for coring and are disintegrated by the drill, or of formations in older wells which should have been cored but were not because the value of the core information was not appreciated at the time of drilling. The latter case is particularly true of wells which are old enough to be ready for secondary-recovery methods as by water-flooding, gas- or air-repressuring, and the like. It is very often found that for these older wells there is a complete lack of core data from which some estimate of future recovery and the choice of a proper depletion method can be made.

Methods and means for taking side-wall cores at any desired depth in these wells have been developed and used with some success. Generally

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these involve the driving of some type of tube or like core-cutting and -holding devices into the side of the hole, cutting the core, and withdrawing it more or less intact inside the cutting tube. However, these devices are often of complicated design. The cores recovered are quite small and frequently the formation material is so crushed in the cutting process as to be lost or washed out of the core tube during removal from the well, or if not lost the core may be so fractured as to have its properties altered.

It is accordingly a primary object of my invention to provide a novel and improved apparatus for obtaining samples of exposed formations penetrated by a well. Another object is to provide a simple and inexpensive side-wall sampling tool capable of recovering samples of the formation relatively intact and of adequate size for laboratory testing purposes to determine porosity, permeability, fluid content, and the like. A further object is to provide an apparatus of the type described that is easy and simple to use, not requiring the setting up of heavy and cumbersome well-servicing equipment, but which can be lowered and operated on a wire line, and with which there is reasonable certainty as to the depth where the sample is taken. Still another object is to provide a sampling tool capable of taking samples from soft, easily fractured formations with a minimum of disturbance and physical damage to the sample. Other objects, uses, and advantages will become apparent as this description of the invention proceeds.

Stated briefly, these objects are accomplished by a sampling tool lowered on a wire line and having pointed or sharpened blades pivoted to the tool at one end and adapted to swing outwardly and engage the formations. Then upon raising and lowering the tool in a simple reciprocating motion these blades dig into and dislodge pieces of the formation which are caught as they fall under gravity by an upwardly opening expansible basket member or catcher at the bottom of the tool. There is thus no uncertainty as to where the fragments recovered are taken from, the crushing action of the tube-shaped samplers is avoided, the likelihood of losing part of the dislodged samples is reduced, and the device is relatively simple, being run on an ordinary wire line and not requiring tubing, insulated electrical circuits, tripping devices, or messengers sent from the surface, or complicated maneuvering for its operation.

The principles and operation of my sampling device will be better understood by reference to

the accompanying drawing in which is shown an embodiment of the invention for illustrative purposes only. In this drawing, in which the same reference numeral is applied to the same or a corresponding part in the different figures:

Figure 1 is a cross section of a well showing the sampler of my invention in sample-taking position therein;

Figure 2 is a longitudinal cross section taken through the main body of the sampling tool;

Figure 3 is a transverse cross section on the lines 3—3 of Figure 2 but with the sampling arms partly extended; and

Figure 4 is a transverse cross section on the lines 4—4 of Figure 2.

Referring now to Figure 1, the sampling tool 9 suspended in a well 10 by a wire line 11 consists generally of a cylindrical body 12 from which project sample-dislodging blades 13 and 14, and which carries an expansible sample-catching means 15 at its lower end. Wire line 11 may extend over a sheave 16 at the surface and be wound on a reel or drum 17 driven by a suitable source of power (not shown) in any conventional manner. The cutting action of blades 13 and 14, which are pressed outwardly against the well formation, is assisted by wire line jars 18, to which may be added an extra weight 19 if desired.

The main body of the sampling tool is shown in more detail in Figure 2, in which the sampling blades 13 and 14 are shown in retracted position for running into a well. The body 12 of the tool consists of the tubular outer member 30 across the upper end of which are located two spaced vertical plates 31 and 32 (Figure 3) through which pass the rods 33 and 34 about which blades 13 and 14 pivot. Force to extend blades 13 and 14 outwardly is applied thereto by a tension spring 35 coupled to inward extensions of blades 13 and 14 by links 36 and 37, the lower end of spring 35 being fixed in tool body 12 by a transverse rod 38. As is shown best by Figure 3, the inner extensions of blades 13 and 14 may be offset so as not to interfere with each other as blades 13 and 14 swing outwardly. Projections 28 and 29 on blades 13 and 14 near the pivots 33 and 34 act as stops on the outward and upward motion of the blade tips, preventing the blades from swinging upward past a horizontal position by abutting against the inside of tubular body 30.

The sampling blades and the sample-catching basket 15 may be held in retracted position for running into a well 11 by providing the blades 13 and 14 respectively with the hooks 40 and 41 which extend through slots in tubular member 30 and an inner sliding sleeve 42, being engaged by the sleeve 42 when it is in a "down" position and released when it is in the "up" position. As shown in Figure 4, the sample catcher 15 consists of a plurality of curved flat springs 43 fastened at their lower ends to tube 30 by a band or collar 44. Between springs 43 extends a flexible sheet or web 45 of fabric such as canvas or similar material. The springs 43 are held in a retracted position flat against the outside of tube 30 by an encircling wire 46 which extends around the outside of the springs, but at the same time passes through holes in outer tube 30 and inner sleeve 42 in such a manner as to be sheared by sleeve 42 in sliding upwardly to release hooks 40 and 41. To the lower end of inner sleeve 42 is fastened a rod 47 extending past the bottom end of tube 30 and terminated in a foot piece 48.

In operation the sampling tool 9 is lowered to the bottom of the well with the blades 13, 14 and the sample catcher 15 in the position shown in Figure 2. As soon as foot piece 48 contacts the well bottom, a simple raising and lowering movement of wire line 11, operating jars 18, forces the sleeve 42 upward relative to tube 30, severing wire 46, and releasing blades 13 and 14. As can be seen in Figure 1, the springs 43 are bowed inwardly at their upper ends so as to slide smoothly along the wall of the well without digging into it, but at the same time they keep web 45 extended and close to the formations. After the sampling tool has been opened in this manner, it is then raised to the level where a sample is desired. The sample is then dislodged by raising and lowering the wire line a short distance, thus operating jars 18, and causing blades 13 and 14 to bite into and remove pieces of the formation. As the dislodged pieces of formation fall downwardly, they are caught by the basket 15 where they remain while the sampler is removed from the well by reeling in the wire line.

While my invention has been described in terms of the foregoing specific embodiment thereof, it should be understood that various modifications will occur to those skilled in the art. My invention therefore should not be considered as limited solely to the specific details of this described embodiment but is best defined by the following claims.

I claim:

1. An apparatus for taking formation samples within a well bore comprising an elongated chamber, means for suspending said chamber within the well bore, means associated with said chamber for urging the chamber downwardly within the well bore, spring-actuated pivoted blade means carried by the upper portion of said chamber adapted to extend therefrom and dislodge portions of the formation, stop means associated with said blades to prevent unrestricted upward movement thereof, a sample-catching means adapted to extend across well bores of varying diameter and carried by said chamber below said blades, expansible substantially into contact with and slidable along the bore walls, removable means for initially retaining the said sample-catching means in a closed inoperative position, means for retaining the blade means in a retracted position, and means for releasing bolts said blade means and said sample-catching means in the region of the formation to be sampled.

2. A wire-line sampling tool for well formations comprising an outer tubular body member, a plurality of blades pivoted to said member and having inwardly extending projections, spring means urging said blades outwardly into the formations of a well whereby said blades remain open after being released, an inner sleeve member slidable within said outer body member for engaging said projections on said blades, a sample-catching means mounted on said outer body member below said blades, said sample-catching means comprising a plurality of longitudinally extending flexible springs with flexible fabric extending therebetween, the outer ends of said springs curving inwardly toward said member, means for retaining said flexible springs in retracted position, and means for moving said sleeve member within said outer body member to disengage said projections and to release said spring-retaining means.

3. A wire-line sampling tool for well formations comprising a cylindrical body member, a

plurality of ports in an upper portion of said body member, a plurality of blade members pivoted to said body member and extending through said ports, spring means urging said blades outwardly from said body member whereby said blades remain open after being released, means mounted on said body member below said blades comprising a retractable basket adapted to extend across substantially the entire cross section of a well bore and having inwardly-curved wall-engaging expansion springs, means retaining said blades and said springs in retracted position, and trip means acting on said retaining means for releasing said blades and said basket within a well to be sampled.

4. An apparatus for sampling formations within a well bore which comprises an elongated body member adapted to be passed within the well bore on a single wire line, formation-dislodging blade means retractably pivoted to an upper portion of said body member, retractable basket means carried by said body member below said blades and having inwardly-curved wall-engaging expansion springs, a single releasable means for retaining both said blades and said basket in an inoperative position, and means for releasing said retaining means whereby said blades and said basket expand respectively to dislodge and to receive pieces of a formation to be sampled.

5. An apparatus for dislodging and recovering portions of selected formations within a well bore comprising an elongated chamber adapted to be lowered on a single wire line into a well bore, spring-actuated blade means extending downwardly and outwardly from said chamber at an upper portion thereof, a retractable basket means carried by said chamber below said blade means and adapted to slidably engage the walls of said bore, releasable means within said chamber adapted to hold said blade means and said basket means in a retracted position, and means for operating said releasable means whereby said blade means and said basket means expand into contact with a formation to be sampled.

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