July 31, 1962 B. A. PETERS ETAL 3,047,072

WELL FLUID SAMPLER

Filed Feb. 15, 1961

FIG. 1.

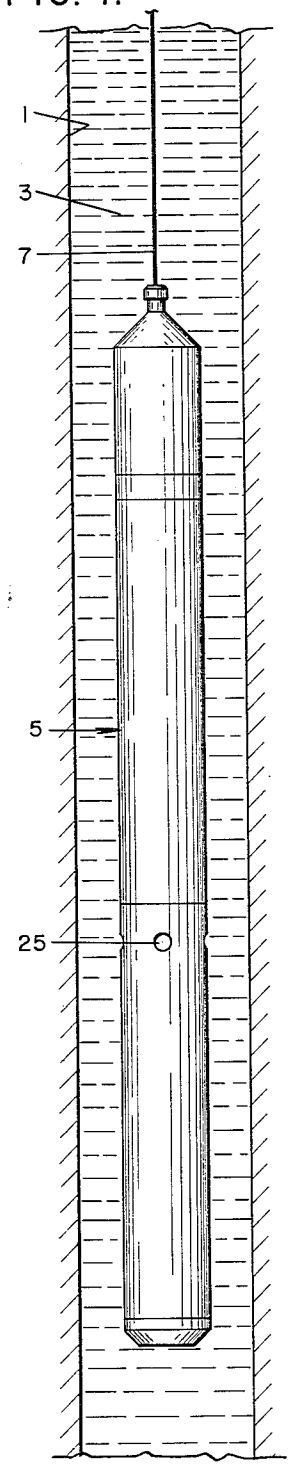


FIG. 2A.

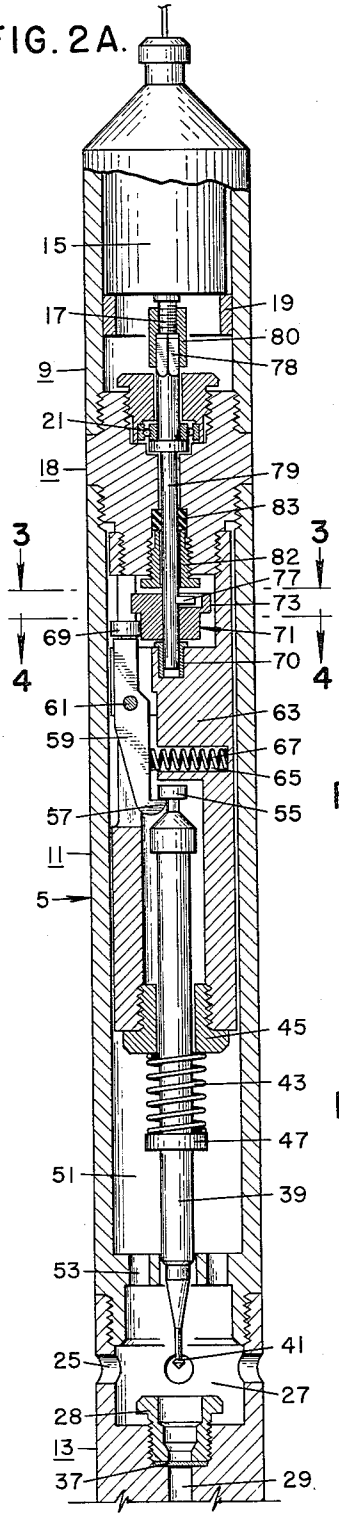


FIG. 2B.

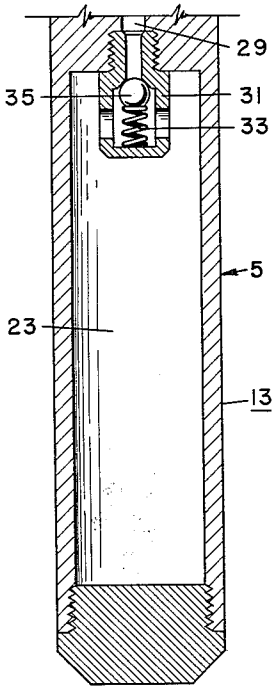


FIG. 3.

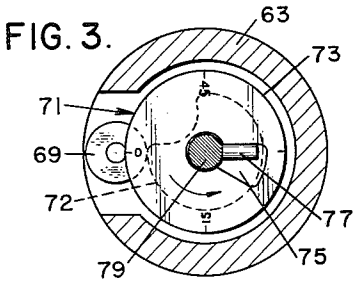
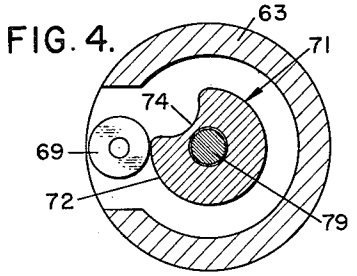


FIG. 4.



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WELL FLUID SAMPLER

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This invention relates to apparatus for obtaining fluid samples, and more particularly to apparatus for obtaining fluid samples under reservoir conditions in well bores.

For a number of reasons it is important to obtain samples of fluids at various levels in well bores, the most important reason being to determine conditions and methods of production that will recover the maximum quantity of hydrocarbonaceous fluids from hydrocarbon-containing reservoirs. Inasmuch as hydrocarbon oil and gas produced at the surface of the ground has quite different physical characteristics at normal atmospheric temperature and pressure than the same fluids have in the reservoir at superatmospheric temperature and pressure, it is necessary to use special apparatus to obtain fluid samples which are truly representative of reservoir conditions.

In connection with the present invention, there is provided an elongated housing adapted to be lowered into a well bore which contains a sample chamber. A passageway is provided from the exterior of the housing to the sample chamber, along with means including an elongated rod member for controlling fluid access into the chamber. The rod member is biased by a spring to an operative position thereof whereat the chamber is opened to fluid entry thereinto. Means including a sear is positioned in the housing to hold the rod away from said operative position thereof so that fluid entry into the chamber is prevented. For the purpose of controlling movement of the sear, there is provided a timing motor, a cam follower on the sear, and a rotatable cam means including a cam surface and a lost motion coupling to the motor. The cam is rotatively driven by the motor, and the cam follower is positioned to follow the cam surface. The cam surface has a substantially constant radius portion and a valley portion such that the cam follower holds the sear in the rod-holding position thereof while following the constant radius portion of the cam surface, and releases the sear when following the valley portion of the cam surface, whereby the rod is released by the sear to open the sample chamber.

Objects and features of the invention not apparent from the above discussion will become evident upon consideration of the following description when taken in connection with the accompanying drawings, wherein:

FIG. 1 is an elevational view of the invention in position in a well bore;

FIGS. 2A and 2B are cross-sectional, elevational views of the invention illustrating details of construction thereof;

FIG. 3 is a cross-sectional view taken along section 3—3 of FIG. 2; and

FIG. 4 is a cross-sectional view taken along section 4—4 of FIG. 2.

With reference now to FIG. 1, there is shown a well bore 1 filled with well fluid 3 to be sampled. An elongated housing 5 is shown suspended in well bore 1 at the end of a wire line 7. As shown more perspicuously in FIGS. 2A and 2B, the housing includes a timing motor section 9, a middle section 11, and a sample chamber section 13.

Positioned within the timing motor section 9 is a mechanically or electrically energized clock timing motor 15 having an output shaft 17. The timing motor 15 is supported in the timing motor section 9 by suitable shock absorbing mounting devices 19. Ball bearings 21 support the output shaft within the housing so as to permit free rotation of the shaft. If an electric timing motor is used, it may be energized either by batteries (not shown) in the housing, or by a power source at the surface through an insulated conductor in cable 7 in the usual maner for logging instruments.

The sample chamber within housing section 13 has a single opening thereinto provided by a passageway from the exterior of the housing into the sample chamber. The passageway includes one or more ports 25 between the exterior of the housing into a chamber 27, a passageway 29 from the chamber 27, and a check valve 31 from passageway 29 into the sample chamber. The check valve 31 includes a conventional ball 35 and coil spring 33 arrangement adapted to oppose fluid entry into the chamber until a predetermined pressure is exerted thereon from the exterior of the chamber relative to the pressure within the chamber. The check valve positively prevents fluid egress from the chamber. A frangible disk 37 is provided for the purpose of sealing the chamber against fluid entry thereinto until the apparatus is at a desired depth in a well.

Positioned immediately above the frangible disk is a spear-like rod member 39 having a spear point 41 adapted to puncture or shatter frangible disk 37 when rod 39 is driven at disk 37 under the impetus of coil spring 43. Coil spring 43 is positioned between a threaded guide nut 45 and an annular flange 47 on the rod 39. Downward movement of the rod is stopped when the flange 47 engages the lower end 49 of compartment 51. Ports 53 provide fluid communiction between compartment 51 and chamber 27 so as to permit free movement of the rod 39. The upper end of rod 39 includes an annular flange or cap 55. The hook portion 57 of a sear 59 is adapted to engage the under portion of the flange 55 so as to hold the rod 39 away from the frangible disk 37 against the force of spring 43. The sear 59 is pivoted on rod 61 on nipple member 63. Housed within a recess 65 in nipple 63 is a coil spring 67 engaging sear 59 so as to bias the sear 59 away from the position at which the hook portion 57 engages the rod flange 55. At the opposite end of the sear 59 is affixed a cam follower 69, which may be a roller member.

Connection between the timing motor output shaft 17 and cam follower 69 is provided by shaft 79, pin 77, and cam 71. The square end 78 of shaft 79 is connected to output shaft 17 by a coupling sleeve 80. Shaft 79 is supported by ball bearing assembly 21 and by sleeve bearing 70. An annular seal 83 held in position around shaft 79 by packing nut 82 prevents fluid entry into timing motor section 9 from housing section 11.

The cam 71 and shaft 79 may be considered as a cam assembly having a lost motion coupling. The details of construction of the cam are best seen in FIGS. 3 and 4. The coupling section 73 of the cam 71 includes a cutout section 75 adapted to receive the driving pin 77 connected to shaft 79. The cutout section extends over an arc of between 45° and 90°.

The cam surface 72 of cam 71 includes a substantially constant radius portion which preferably extends over at least 270° of the surface, and a valley portion 74 which preferably extends over somewhat less than 90° of the surface. The cam follower 69 engages the cam surface 72 so as to hold the sear in the position shown in FIG. 2A whereat the rod 39 is held away from disk 37 while the cam follower 69 is following the constant radius portion of cam surface 72. When the cam follower 69 rolls into valley 74, the cam will almost instantly rotate through the angle of movement defined by cutout 75 to release sear 59 for pivotal motion under the impetus of spring 67.

The operation of the above-described apparatus is as

follows. The timing motor 15 is wound or energized and the housing sections 9 and 18 are connected together. Coupling section 80 with slip over square shaft end 78. Frangible disk 37 is inserted in housing section 13 and locked in place with disk retaining screw 28. To cock the apparatus, spear rod 39 is pushed upwardly, as viewed, and motor 15 is rotated until cam follower 69 rides at a desired position on cam surface 72. Housing section 13 is then connected to section 11.

The apparatus is lowered into the well until it is at a desired depth. Timing motor will rotate shaft 79 and cam 71 through the lost motion coupling until cam follower 69 enters cam valley 74. The cam will instantly rotate through the angle allowed by the lost motion coupling and sear 59 will pivot to release rod 39 so that spear end 41 punctures disk 37. Inasmuch as the fluid pressure at well depths is substantially greater than the atmospheric pressure within chamber 23, check valve 31 will open to permit fluid flow into chamber 23. When the differential pressure between the well bore 1 and the chamber 23 is less than the pressure exerted by spring 33 on ball 35, the check valve 31 will close. The apparatus can then be retracted from the well bore, with the fluid in chamber 23 under substantially reservoir conditions.

The present invention is particularly advantageous in that a relatively tremendous amount of energy for actuating the well sampler is easily controlled by a relatively weak clock timing motor. Clock mechanisms used in subsurface instruments develop torques that are seldom above 16 to 18 inch ounces. The clock power is transmitted by the cam 71 and cam follower 69, which are substantially friction free, to the sear to release the sear from its cocked position. The cam and cam follower hold the sear in position in a manner which makes it impossible to prematurely trip by shock. The snap action release of the sear releases the sear almost instantly so that a relatively tremendous amount of power is available to puncture disk 37.

The invention is not necessarily to be restricted to the specific structural details or arrangement of parts herein set forth, as various modifications thereof may be effected without departing from the spirit and scope of this invention.

What is claimed is:

1. A well sampler comprising:
a housing:
a timing motor in said housing:
a sample chamber in said housing;
means controlling fluid access to said sample chamber including a passageway between said chamber and the exterior of said housing, a closure in said passageway, an elongated rod, and spring means connected to said rod for dirving said rod to an operative position of said rod to open said closure and permit fluid entry into said chamber;
a sear positioned in said housing to hold said rod away from said operative position thereof;
spring means supported in said housing and connected to said sear for urging said sear away from the rod-holding position thereof;
a rotatable cam assembly connected to said timing motor, including a cam having a cam surface, and a lost motion coupling for coupling said cam to said motor, said cam surface having a substantially constant radius portion and a valley portion; and
a cam follower on said sear in following relationship with said cam surface to hold said sear in the rod-holding position thereof while following the constant radius portion of said cam, and to release said sear from the rod-holding position thereof while following the valley portion of said cam whereby said sear releases said rod to open said sample chamber.

2. A well sampler comprising:
a housing;
a timing motor in said housing;
a sample chamber in said housing;
means controlling fluid access to said sample chamber including a passageway between said chamber and the exterior of said housing, a closure in said passageway, an elongated rod, and spring means connected to said rod for driving said rod against said closure to an operative position of said rod to open said closure and permit fluid entry into said chamber;
a sear positioned in said housing to hold said rod away from said operative position thereof;
spring means supported in said housing and connected to said sear for urging said sear away from the rod-holding position thereof;
rotatable cam means;
driving means connecting said cam means to said timing motor including a lost motion coupling adapted to permit free rotation of said cam means through a limited arc of movement;
said cam means having a cam surface with a substantially constant radius portion and a valley portion; and
a cam follower on said sear in following relationship with said cam surface to hold said sear in the rod-holding position thereof while following the constant radius portion of said cam, and to release said sear from the rod-holding position thereof while following the valley portion of said cam assembly whereby said sear releases said rod to open said sample chamber.

3. A deep well sampler comprising:
an elongated housing;
a sample chamber in said housing;
a passageway into said chamber from the exterior of the housing;
a frangible seal in the passageway;
a spear-like member in said housing positioned in line with said seal to be driven at said seal for rupturing said seal;
spring means supported in said housing and connected to said spear-like member to drive said spear-like member at said seal;
a sear pivotally supported in said housing latching said spear-like member to hold said spear-like member away from said seal against the force of said spring;
a timing motor in said housing;
a cam shaft in said housing, connected to said timing motor and driven by said timing motor;
a cam on said shaft;
a lost motion coupling connecting said cam to said shaft so as to permit said cam to freely rotate through a predetermined arc of movement between 45° and 90° on the shaft and adapted to be rotatively driven by said shaft, said cam having a cam surface with a first substantially constant radius portion and a cam valley;
a cam follower on said sear biased against the cam surface of said cam so that said cam surface holds said sear in latching relationship with said spear-like member while following the constant radius portion thereof, and to release said spear-like member when said cam follower rolls into said valley; and
means in said housing connected to said sear to urge said cam follower against the cam surface.

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