May 21, 1940. S. A. MULLINS 2,201,447

FLUID TAKING TOOL FOR OIL WELLS OR THE LIKE

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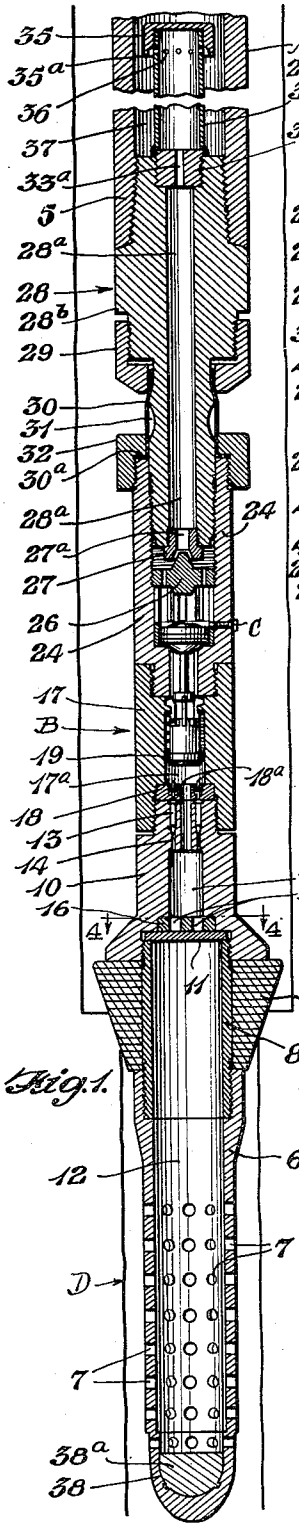

Fig. 1.

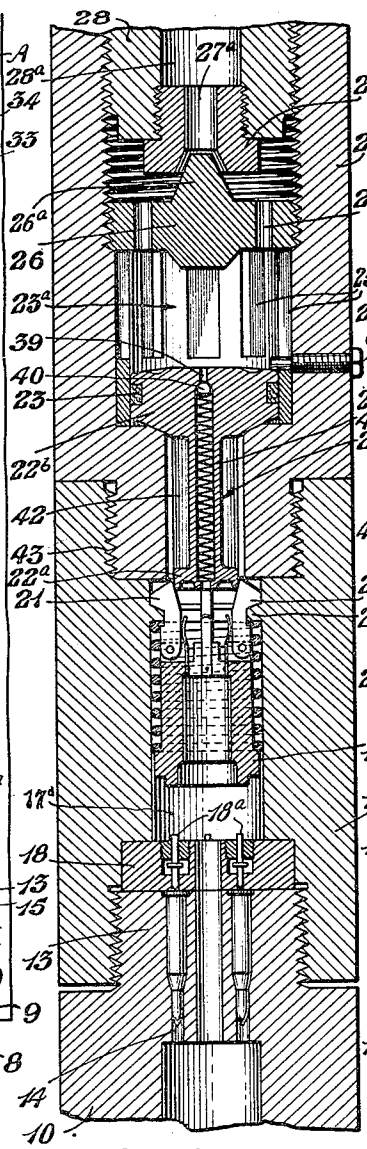

Fig. 2.

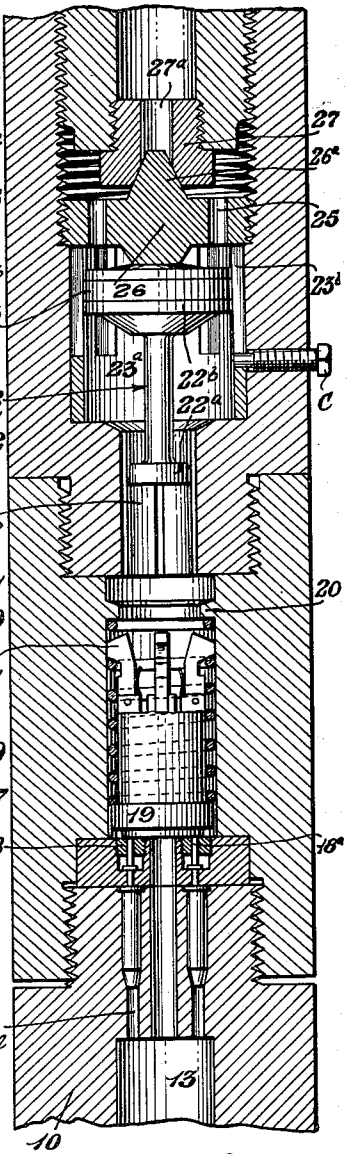

Fig. 3.

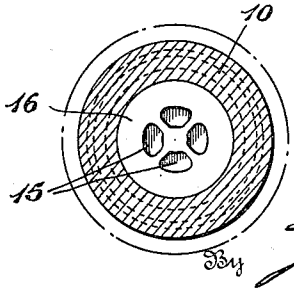

Fig. 4.

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FLUID TAKING TOOL FOR OIL WELLS OR THE LIKE

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Application May 27, 1938, Serial No. 210,499

13 Claims. (Cl. 166—1)

This invention relates to improvements in well formation testing and sampling tools such as are commonly used to ascertain the quality and quantity of oil, gas and the like, as a producing sand is encountered at any level during a well drilling operation.

The present invention is directed primarily to improvements in the character of tool which is described and claimed in my copending application Serial No. 174,442 for "Sample taking tool for oil wells," filed November 13, 1937, now Patent Number 2,128,212, August 23, 1938; and has for an object to provide a protected and more positively operable cartridge firing mechanism, which like that shown in said earlier application, may be operated by a predetermined decrease in pressure above the firing mechanism in the hollow drill stem.

Another object of this invention is, therefore, to produce a greatly simplified multiple cartridge firing mechanism including a trigger and hammer and means cooperating with said mechanism whereby release of the trigger may be effected on a predetermined increase, as well as a decrease in operating pressure in the drill stem above said mechanism.

Another object of my invention is to provide a positively operable shut-off or sample-taking valve and a sediment trap which is rotatably mounted in the upper end of the tool and which is formed with a hollow extension which provides an operative connection between the lower end of the drill stem and the tool body.

A further object of my invention is the provision of a flow-choking means in combination with means providing a sediment trap and a flow shut-off valve whereby said parts may be expeditiously manufactured and assembled for economical and dependable operation.

A still further object of my invention is to provide an improved tool connection sealing means in the form of a deformable imperforate sleeve which is constructed to surround the upper relatively rotatable stem-joining end position of the tool with the tool body, whereby leakage of mud and water through said connection to the interior of the tool and about the shut-off valve is prevented.

Other objects of my invention relate to the provision of means in the nose or lower end of the tool to absorb impact of projectiles fired through the sealing plate to thus prevent splatter and damage to the nose of the tool and to thus improve the general details of construction of the tool as a whole, all as will be more fully described in the following specification, and shown in the accompanying drawing, in which:

Fig. 1 is a view in sectional elevation of a testing and sampling tool constructed in accordance with the features of the present invention;

Fig. 2 is an enlarged view in longitudinal vertical section of the intermediate portion of the tool of Fig. 1, particularly illustrating the firing and coacting valve mechanism, the parts in this figure being shown in unfired position;

Fig. 3 is a view similar to Fig. 2 but showing the position of the parts after firing; and,

Fig. 4 is a transverse section taken on the line 4—4, Fig. 1.

In the drawing, now being described, A indicates a drill stem which is of tubular construction having an internally threaded end portion 5. This end portion 5 of the stem is rigidly connected, by means of the threads, to the upper end of my improved sample taking tool indicated generally at B.

As in the case of the tool of my former application Serial No. 174,442, now Patent Number 2,128,212, the tool B comprises a cylindrical body or casing which is preferably made up of a plurality of concentric sections which are connected together by screw threaded end portions, the lower or nose section 6 being circumferentially and longitudinally perforated as at 7 to permit oil or gas to enter the tool when lowered into a producing sand in the usual manner.

To the upper end of this nose section 6 is threaded a tubular section 8 around which a conical packer unit 9 of usual construction is longitudinally secured and confined between the upper end of section 6 and the lower end of cartridge-carrying and seal-securing section 10, which latter section is threaded on the upper end of the tubular section 8. In like manner, a sealing disc 11 is confined between the upper end of the tubular section 8 and an annular shoulder formed within the threaded recessed lower end of the cartridge carrying section 10. This sealing disc 11, which is preferably formed from sheet steel, normally closes the upper end of the oil or gas receiving chamber 12 and thus prevents passage of any of the oil or gas to the interior of the tool above the seal until the seal is perforated for that purpose.

The section 10 of the tool is preferably made heavier than the lower adjoining sections and is provided with a centrally reduced part 13 and an annular series of bores or barrels 14. Each of the bores 14 is formed, as shown in Figs. 2 and 3, to receive and support a cartridge with the

projectile end of the cartridge directed at the sealing disc 11, through the aligned openings 15 in the sealed reinforcing plate 16. This latter plate ensures against premature rupture or displacement of sealing disc 11.

The upper bored end portion of the section 10 is externally reduced and threaded into the recessed lower end of firing chamber section 17 to a point where it will abut the underside of the removable firing pin-carrying ring 18. This ring 18 is thus held in fixed position against an annular seat in the recessed lower end of the firing chamber 17a of section 17 with the protruding ends of the firing pins 18a aligned with the cartridges carried in the section 10 and an annular lower face on a cylindrical spring-pressed hammer member 19 which is slidably mounted in the chamber 17a above the pins 18a.

An annular rib or shoulder 20 is formed in section 17 adjacent the upper end of the cylindrical firing chamber 17a so as to project radially into said chamber. This rib is provided with an inwardly and downwardly tapering upper face on which a plurality of spring-pressed, hammer-releasing latches 21 are normally held by action of a piston-operated trigger or actuator generally indicated at 22. As best shown in Figs. 2 and 3, the actuator 22 includes a lower latch-engaging portion 22a and a piston 22b provided with a piston ring 23. Piston 22b is slidably mounted in a valve chamber 23a formed in the lower part of tool section 24, the wall of the chamber being formed with a plurality of longitudinal clearance channels 23b, so that when the piston 22b moves upwardly into the chamber 23a, fluid is permitted to pass around the said piston and upwardly through valve ports 25 formed in valve seat 26, the latter being formed with an upper conical portion 26a. Above the valve seat is a valve closure member 27 which is formed with a central port 27a and is threaded into the lower end of coupling member 28, the latter having a central bore or conduit 28a extending therethrough and at its upper end being formed with an externally threaded boss which is threaded into the lower end 5 of the drill stem A. The member 28 is provided with a shouldered portion 28b and below this shoulder the said member is reduced and externally threaded to receive a fitting 29 adapted to exert a clamping action or thrust on the upper end of a flexible deformable sealing sleeve 30 and clamp the latter around a reduced portion of the member 28. This reduced portion is formed with an annular clearance recess 31 to facilitate torsional flexing of the sleeve 30 in a manner to be described, the lower extremity of the said sleeve being formed with a sealing gasket portion 30a which is clamped securely against the upper end of the tool section 24 through the medium of a fitting 32.

This sleeve 30 may be made of copper tubing or other relatively thin flexible material and its function is to provide a seal around the tool section 24 at the point where it is connected or coupled to the relatively movable member 28, as will be more fully explained in connection with the description of the operation of the tool.

Threaded into the upper end of the central bore 28a of the member 28 is a choke 33 having a reduced bore 33a therein. This choke member provides a reduced passage of known flow capacity whereby fluid passing therethrough may have its rate of flow accurately determined for use in obtaining test data.

Above and communicating with the bore 33a of choke 33 is a trap cylinder or receptacle 34 having a cap 35 threaded over the upper end thereof, said cap being formed with a depending baffle or annular skirt portion 35a which overlies a circumferential series of ports or apertures 36 formed adjacent the upper end of the cylinder 33. By this means sediment or foreign weighty matter entering the drill stem A above the trap 34 will be deflected upon striking the cap 35 into the annular space 37 between the trap cylinder 34 and surrounding wall of drill stem A.

At the opposite end of the tool the nose section 6 is preferably formed at its lower extremity with a chamber 38 having anchored therein material such as lead 38a which is capable of cushioning or absorbing shock due to impact of the projectiles fired through the sealing plate 11, to thereby prevent splatter and damage to the nose of the tool.

To insure against accidental displacement or premature lifting of the piston 22b and the actuator 22a while handling of the tool or during transportation, a screw C may be threaded into the section 24 so that its inner end projects inwardly immediately above the said piston. When the tool is ready for lowering into the casing, this screw C is backed off to the position shown in Fig. 3.

In operation, assuming that the firing mechanism is loaded and the hammer member and actuator is in cocked position, as shown in Figs. 1 and 2, the drill stem A, with the tool assembly connected thereto is lowered into the well until the packer unit 8 is seated in the upper end of the "rat hole" D. To fire the mechanism, a subatmospheric or suction action may be set up in the chamber 23a above the piston 22b by evacuating air from said chamber, whereupon the said piston is lifted or drawn upwardly, releasing the actuator 22a from its position between the latches 21 and permitting the spring-pressed hammer 19 to be forced downwardly against the firing pins 18a. The cartridges will thus be discharged to fire the projectiles from the barrels or bores 14, through the holes or openings 15 in the backing plate 16 and piercing the sealing disc 11. Fig. 3 shows the position of these parts after firing. Fluid under pressure in the chamber 12 of the nose section 6 may now flow upwardly past the actuator 22a and its piston 22b, through the ports 25 and 27a, upwardly into and through passage 28a and choke port 33a into trap cylinder 34 and outwardly through apertures 36 into the hollow drill stem above the annular trap space 37.

When this has occurred and the desired readings have been taken at the upper end of the hollow drill stem, not shown, the valve port 27a is closed. To accomplish this the drill stem may be rotated relative to the tool body B to in turn rotate the coupling member or section 28, causing valve member 27 to seat on the conical portion 26a of the valve seat 26 in the upper end of the tool. It is preferred that the pitch of the external threads in the lower end of the coupling member 28 be such as to require only one turn or a partial turn of the drill stem to effect seating of this valve member.

Since there will be relative rotational or angular movement between the coupling section 28 and the tool body B the sealing sleeve 30 will be twisted between its upper and lower secured end portions, but due to the fact that said sleeve is comprised of flexible material, and further, due

to the annular recess 31 which provides clearance for buckling, the said sleeve will be permitted a certain amount of torsional or twisting action without breakage or rupture.

In some instances it may be desired to withdraw the actuator 22a through the medium of pressure instead of vacuum. To provide for this contingency, the piston 22b is provided with a valve port 39 having a one-way valve 40 seated thereon and normally urged to seated position by means of spring 41. When it is desired to fire the mechanism through the medium of air or fluid pressure, such pressure is built up in the chamber 23a through the hollow drill stem A, the pressure being communicated to chamber 42 below the piston through port or passage 43. After a predetermined amount of pressure is built up in chamber 42, pressure is relieved from the drill stem A and connected passageways to the chamber 23, whereupon the piston 22b together with the actuator 22a will be forced upwardly effecting release of the latches 21 in the manner heretofore described.

To reload the firing mechanism, section 10 may be unthreaded from firing chamber section 17, barrels or bores 14 loaded with projectiles, the hammer 19 pushed upwardly to latched or cocked position and the parts replaced as illustrated in Fig. 1 with the screw C threaded in to engage and hold the piston 22b.

It would seem that the improved tool effectively carries out the aforementioned and other objects; and it will be understood that the drawing is simply an illustration of a preferred arrangement for carrying out such objects and that certain changes in the construction and design of the tool may be adopted within the scope of the invention as defined by the appended claims.

I claim:

1. In a testing and sampling tool for oil wells and the like, means providing a conduit for the fluid to be sampled, a seal closing one end of said conduit, one or more projectiles loaded with an explosive substance mounted above said seal, a hammer member slidably mounted above said projectiles for firing the explosive charges thereof, and radially movable latch means carried by said hammer member, and latch holding means for releasing said hammer member releasable through super or sub-atmospheric pressure for releasing said hammer member.

2. In a testing and sampling tool for oil wells and the like, means providing a conduit for fluid to be tested, a seal closing the one end of said conduit, one or more projectiles loaded with an explosive substance mounted above said seal, a hammer member adapted to ignite said explosive, a slidable hammer-release member having a fluid-actuated piston associated therewith, and a normally closed fluid bypass associated with said piston and having releasable means whereby fluid pressure may be built up therebelow to actuate the same and said hammer-release member.

3. In a testing and sampling tool for oil wells and the like, means providing a conduit for the fluid to be sampled, a seal closing one end of the conduit, one or more projectiles loaded with an explosive substance mounted over said seal, means for igniting said explosive including a hammer member and an actuator and a slidable piston having an operable connection with said actuator, said piston being provided with a port and a one-way valve controlling said port whereby fluid pressure may be transmitted from a point above the piston to the underside of the latter to effect release of the piston.

4. In a testing and sampling tool for oil wells and the like, means providing a conduit for the passage of fluid, means sealing one end of said conduit, one or more projectiles loaded with an explosive substance mounted above said seal, means for firing said projectile to rupture the seal and permit fluid to flow upwardly through said conduit, a valve unit mounted in said passage for closing off the latter after the sample fluid has been trapped, said valve unit including a valve seat and a valve member coacting with said seat and adapted to be moved towards closed position through relative rotation of the parts carrying said member and seat.

5. In a testing and sampling tool for oil wells and the like adapted to be connected at one end to the lower end of a drill stem or analogous member and having an oil or gas-receiving chamber connected to its opposite end and a conduit communicating said chamber with said drill stem, a seal closing off said conduit from said chamber, means for rupturing said seal to permit test fluid to pass from said chamber through said conduit into the drill stem and including projectile-firing mechanism and a reciprocating firing actuator having a lift piston associated therewith, a hollow section providing a valve chamber and said piston being mounted for reciprocatory movement in said chamber, a valve seat mounted in said chamber above said piston, a coupling member connected at its upper end to said drill stem and at its lower end having a threaded connection with said valve housing section, a valve closure member connected to the lower end of the coupling member and adapted to coact with said seat and whereby the valve may be closed or opened through relative rotation between said coupling member and said section.

6. In a testing and sampling tool for oil wells and the like adapted to be connected at one end to the lower end of a drill stem or analogous member and having an oil or gas-receiving chamber connected to its opposite end and a conduit communicating said chamber with said drill stem, a hollow valve housing section having a valve therein, a coupling member which at its lower end has a threaded connection with said section, a valve closure member associated with said coupling member and whereby the valve may be closed or opened through rotation of the drill stem, and a seal associated with said coupling member and section, said seal being in the form of a sleeve comprised of flexible material surrounding a portion of said coupling member adjacent said section, means clamping said sleeve around said coupling member and against a portion of said section.

7. In a testing and sampling tool for oil wells and the like adapted to be connected at one end to the lower end of a drill stem or analogous member and having an oil or gas-receiving chamber connected to its opposite end and a conduit communicating said chamber with said drill stem, a seal closing off the lower end of said conduit from said chamber, means for rupturing said seal to permit test fluid to flow from said chamber through the conduit into the drill stem, a hollow valve housing section having a valve therein, a coupling member which at its upper end is connected to said drill stem for rotation therewith and at its lower end has a threaded connection with said section, whereby the valve may be opened or closed through relative rotation

of said drill stem with respect to said section, a seal in the form of a sleeve comprised of flexible material clamped at one extremity around said coupling member and at its opposite extremity clamped against the upper end of said section, the coupling member being provided with an annular recess within the region of said sleeve whereby clearance is provided to facilitate buckling of the sleeve when the coupling member is rotated with respect to the section.

8. In a testing and sampling tool for oil wells and the like adapted to be connected at one end to a drill stem or analogous member and having an oil or gas-receiving member connected to its opposite end and a conduit communicating said chamber with said drill stem, a choke member having a port therethrough of reduced dimensions with respect to said conduit, and a sediment trap in the form of a receptacle connected to said choke member and having baffle means associated therewith against which the fluid impinges prior to passing into said drill stem.

9. In a testing or sampling tool for oil wells and the like adapted to be connected to the lower end of a drill stem or analogous member, an oil or gas-receiving chamber connected to the lower end of said tool, a conduit communicating said chamber with said drill stem, a seal closing off said conduit from said chamber, means for rupturing said seal to permit test fluid to flow through said conduit into the drill stem and including a series of projectiles and firing mechanism for firing said projectiles through said seal, and a backing plate overlying said seal and formed with openings aligned with said projectiles.

10. In a testing and sampling tool for oil wells and the like adapted to be connected to the lower end of a drill stem or analogous member, an oil or gas-receiving chamber connected to the lower end of said tool, a conduit communicating said chamber with said drill stem, a seal of sheet or analogous relatively thin material closing off said conduit from said chamber, means for rupturing said seal including one or more projectiles and firing mechanism for firing said projectiles through said seal, and a backing plate for reinforcing said seal superimposed on the latter and formed with one or more openings in registration with said projectile.

11. In a testing and sampling tool for oil wells and the like, a perforated nose portion defining an oil or gas-receiving chamber, a seal closing off said chamber, means for firing a projectile through said seal, and means carried by said nose portion for cushioning and absorbing shock resulting from firing of said projectile.

12. In a testing and sampling tool for oil wells and the like comprising a housing having an oil or gas-receiving chamber and a conduit adapted to communication with said chamber, means for controlling the communication therebetween including a coupling adapted to be connected to the lower end of a drill stem or analogous member, means providing a relatively movable connection between said coupling and said housing whereby said communication controlling means may be affected through said drill stem or analogous member, and a deformable sealing sleeve connected to said housing and said coupling over said connection.

13. The structure defined in claim 1 in which the conduit for the fluid to be sampled is divided into two relatively movable parts, means for controlling the communication between said parts and means for providing a relatively movable flow control coupling between said parts, and a deformable sealing sleeve connected to the relatively movable portions of the conduit and extending over said coupling.

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