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SAMPLE TAKING TOOL FOR OIL WELLS

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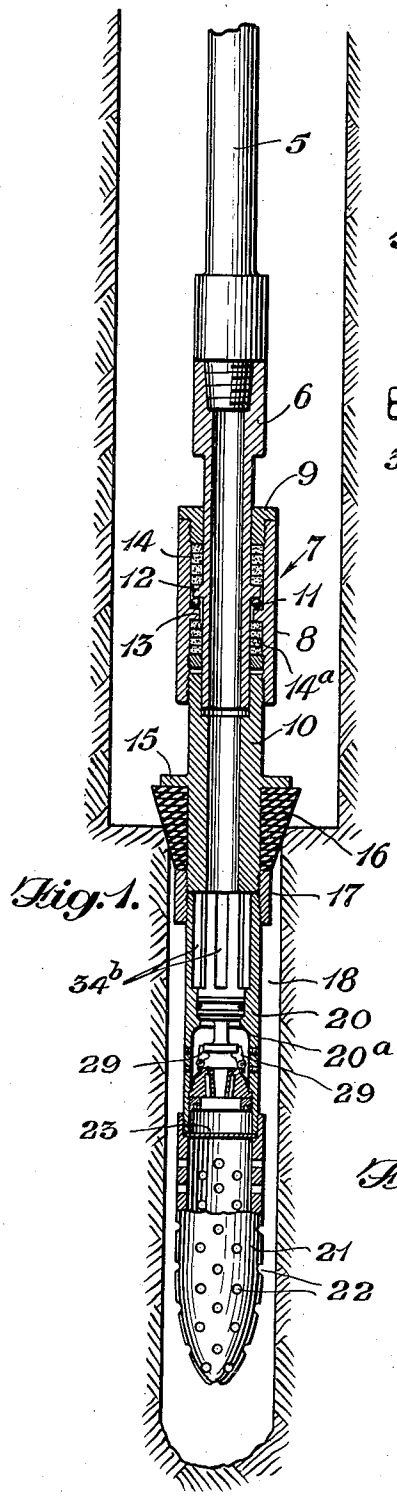


Fig. 1.

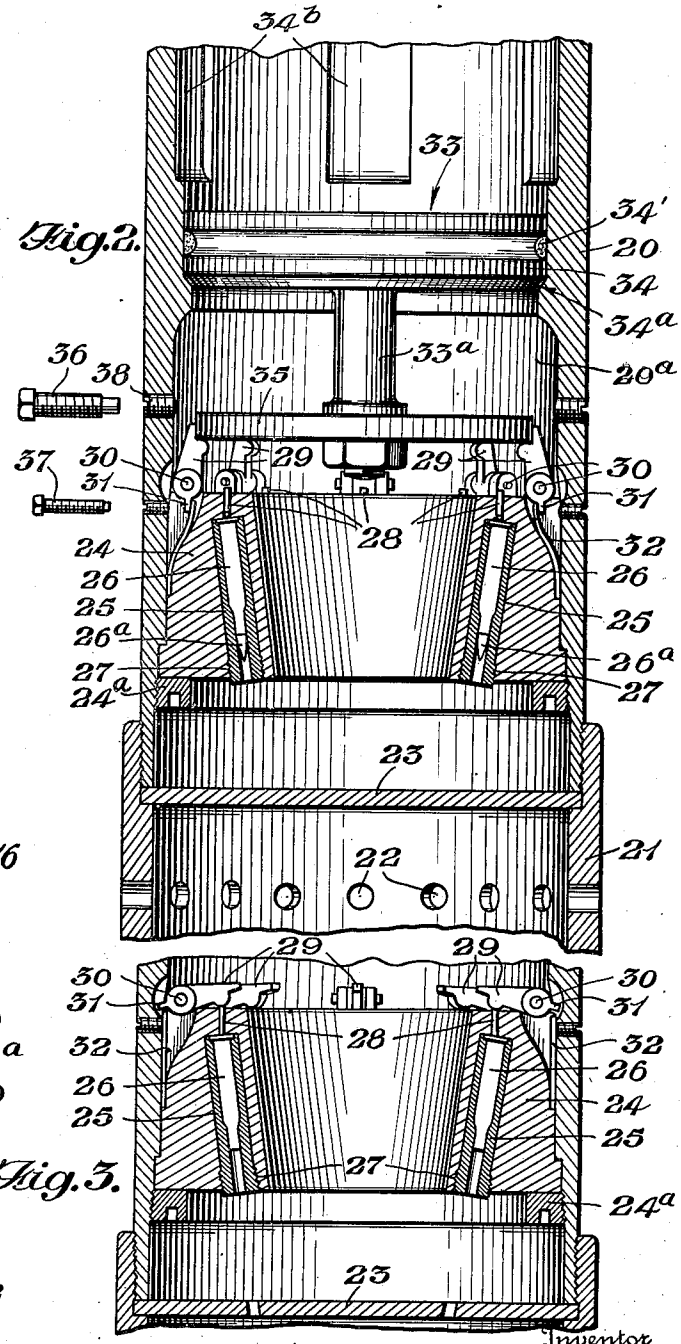


Fig. 2.

Fig. 3.

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SAMPLE TAKING TOOL FOR OIL WELLS

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12 Claims. (Cl. 166—1)

This invention relates to improvements in well formation testing or sampling tools commonly used in ascertaining the quality and quantity of oil, gas and the like as it exists in a formation at any desired drilling level. The improved tool has been devised to overcome certain objectionable features found in tools of this general type as heretofore constructed. For example, certain types of sampler tools have been devised with exposed valves and operating mechanism which become fouled and thus fail to function properly due to the mud and other foreign materials in the well blocking or sanding up their action, with the result that the valves close either prematurely, prior to taking the sample, or fail to operate properly when the sample is taken. Such types of tools generally employ a mechanism which is controlled by the dropping of a weight, known in the art as a "devil chaser", from the top of the well or ground surface through the drill stem to effect the release of a valve latch in the tool and thereby open the valve for admission of a sample of the fluid into the tool and drill stem. In this type of tool, as aforestated, the mud and sand encountered at the zone of test ofttimes causes the valves to foul and stick, or an operating weight to hang in the drill stem, preventing proper operation of the tool which causes pollution of the sample and renders it unfit for a correct analysis.

Other types of sample taking tools have valves which are adapted to be actuated by the weight of the drill stem on the tool after seating in the formation or "rat hole." In this type, considerable difficulty is likewise encountered in preventing leakage, and clogging or sanding of the valve, as well as premature opening of the valve due to striking an obstruction at some point above the desired test level.

In sampling tools of the type wherein the valve is opened by relative rotation of the drill stem, it has been found that due to the difficulty in obtaining the exact degree of rotation from the top of the well, the packer, used to pack the tool off from the mud column in the well, becomes damaged and the seal between the sand to be tested and the mud column in the well is thus destroyed.

An object of the present invention, therefore, is to provide a testing or sampling tool which meets and overcomes the foregoing difficulties, and which at the same time is positive in operation and relatively simple in construction.

Another object of the invention is to provide means in a tool of the type specified permitting the drill stem to be freely rotated from the top of the well or at the ground level without damaging the sealing effect of the packer.

Another object of the invention is to generally improve tools of this class.

The foregoing and other objects and advantages will become apparent in view of the following description taken in conjunction with the drawing, wherein:

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

Fig. 2 is an enlarged view in longitudinal section of the valve housing portion of the tool, the mechanism for breaking the seal being shown set or cocked for the seal breaking operation; and,

Fig. 3 is a view of a portion of the valve housing of Fig. 2 showing the seal-releasing or puncturing mechanism after it has been fired or released.

Referring now to the drawing in detail, the numeral 5 indicates the lower end of a drill stem which has threaded on the end thereof a tubular connection or hollow stem 6 forming part of a coupling unit generally indicated at 7, said unit including a nipple 8, a cap screw 9, a lower tubular connection or hollow packer stem 10, and a bearing 11. The stem 6 is formed with an annular bearing flange 12 and the sleeve 8 is formed with a similar flange 13, said flanges coacting to provide a bearing race for the bearing 11 and which is shown as of the ball type. Suitable packing 14 and 14a is inserted in the sleeve 8 above and below the flanges 12 and 13.

The member 10 is formed with a flange 15 below which a packer unit 16 is inserted and is held in position by means of a threaded coupling 17.

When the unit is lowered into the casing with the packer 16 in sealing position above the "rat hole" 18, the weight of the drill pipe will be taken by the bearing 11, so that the drill stem and connections thereto may be freely rotated without interfering with the position of the packer 16, or without causing rotation of the latter.

The improved valve assembly is housed in a short pipe length or connection 20 defining a valve housing and a chamber 20a, the member 20 at its upper end being connected to the member 10 by the coupling 17 and at its lower end having connected thereto an inlet nipple 21 which is formed with a plurality of inlet holes or perforations 22. Between the upper end of the nipple 21 and the lower end of the valve housing 20 a sealing disc 23 of any suitable material of sufficient strength to withstand the pressures to

which it may be subjected is provided such as steel or malleable iron. Above the disc or seal **23** is mounted a gun ring **24** formed with one or more bores for receiving one or more gun barrels **25** in each of which a cartridge **26** may be inserted. These barrels **25** are removable for loading purposes and for this purpose may be threaded into the bores provided therefor as indicated at **27**, the heads thereof being suitably slotted to receive a screw driver or the like to facilitate removal. Firing pins **28** are mounted in openings provided therefor in the ring **24** in firing alignment with the cartridges **26**, and these pins may be driven into firing position by means of triggers **29** pivotally mounted on bearing pins **30** above the gun ring **24**, each trigger being formed with a lug or projection **31** which is engaged by an actuating spring **32** secured at one end to the periphery of the barrel **24**. The gun ring may be locked in position in the chamber **20***a* by a threaded retaining ring **24***a*.

A main piston valve generally indicated at **33** is slidably mounted in the cylindrical chamber **20***a* of the housing **20** and is provided with a depending stub **33***a* having thereon a trigger release member in the form of a disc **35**, which at its periphery is adapted to engage the respective triggers **29** and hold the latter in cocked position. This valve **33** is provided with a closure member in the form of a piston **34** having a sealing ring **34'** therein. A valve seat **34***a* is formed around the inner wall of the housing **20** on which the closure member or piston **34** is adapted to seat. Above the valve **33**, the inner wall of the cylindrical housing **20** is formed with a series of clearance channels **34***b*.

During shipment, and while handling prior to actual use or lowering to sample-taking position, screws **36** and **37** may be screwed through the wall of the housing **20** and into positions to lock the trigger disc **35** in its lowermost position to hold the triggers **29** in cocked position and thus avoid any danger of premature lifting of the valve and consequent explosion of the cartridges **26**. When the tool is lowered into the casing, these screws are of course removed and substituted by plugs **38**.

In operation, the drill stem **5** with the improved testing tool thereon is lowered into the casing until the packer **16** seats on the "rat hole" **18**, whereupon a suction or vacuum pressure is applied to the piston valve **33** by exhausting air from the hollow drill stem, pulling the latter upwardly and releasing the triggers **29**, the latter striking the firing pins and firing the cartridges **26** and discharging the projectiles **26***a* into and through the sealing disc **23**. Fig. 2 shows the position before firing and Fig. 3 the position after firing. When the seal is pierced by either one or a plurality of projectiles, the fluid from the sand to be tested passes through these perforations and upwardly through the chamber **20***a* past the unseated closure member **34** and into the hollow body of the tool and drill pipe. After a certain amount of the fluid has been permitted to pass into the pipe, the main valve is closed due to static pressure and gravity of the fluid column trapped within the drill stem.

It will be seen that with this type of tool, all of the valve parts or actuating mechanism are enclosed by the housing **20** and fully protected from premature actuation. Furthermore, the seal piercing action is positive and may be caused to operate at any desired time.

It will be understood that the drawing is simply an illustration of a preferred arrangement for carrying out the enumerated objects, and that certain changes in construction and design may be adopted within the scope of the invention as defined by the appended claims.

I claim:

1. In a testing or sampling tool for oil wells and the like, a hollow member providing a substantially closed housing, a seal closing one end of the housing, means within the housing impelled by an explosive substance for piercing said seal permitting fluid to pass into and through the housing, and valve means operating to close the housing subsequent to passage of fluid therethrough.

2. In a testing or sampling tool for oil wells and the like, a tubular member providing a closed housing, a seal closing one end of the housing, one or more projectiles loaded with an explosive substance mounted above said seal within the housing, means for igniting said explosive substance to discharge the projectiles into and through the seal and pierce the latter, permitting fluid to pass into and through the housing, and valve means operating to close the housing subsequent to passage of fluid therethrough.

3. In a testing or sampling tool for oil wells and the like, a tubular member providing a receptacle for the fluid to be tested, a movable valve for trapping fluid to be tested in said receptacle, a seal for closing the receptacle until the tool is in position to receive the fluid, means within the receptacle impelled by an explosive substance for piercing said seal permitting the fluid to pass into said receptacle, and means associated with said valve for igniting the explosive.

4. In a testing or sampling tool for oil wells and the like, a tubular member providing a receptacle for the fluid to be tested, a housing connected to said member, a movable valve in said housing for trapping test fluid in the receptacle, a seal closing off passage of fluid into the receptacle until the tool is in position to receive the fluid, a projectile loaded with an explosive substance mounted in said housing and directed toward said seal, a trigger for firing said explosive, and means controllable from a point remote from the tool for releasing said trigger.

5. In a testing or sampling tool for oil wells and the like, a drill stem, a tubular member connected to said stem, a housing in communication with said tubular member and having a movable valve in the upper portion thereof, a sealing disc closing the lower end of said housing, means supporting one or more loaded projectiles mounted in said housing and directed at said seal, triggers mounted in firing proximity to said projectiles, and means associated with said valve for holding said triggers in cocked position.

6. In a testing or sampling tool for oil wells and the like, a drill stem, a tubular member connected to said stem, a housing constituting an extension of said tubular member and having a valve seat therein and a movable valve adapted to engage said seat, a seal closing the lower end of said housing, means supporting one or more loaded projectiles in said housing and directed at said seal, triggers mounted in firing proximity to said projectiles, and a trigger release member connected to said valve for holding said triggers in cocked position, said release member being freed from said triggers upon unseating of said valve.

7. In a testing or sampling tool for oil wells and the like, a drill stem, a tubular member connected to said stem and providing a receptacle for fluid to be tested, a housing constituting an extension of said tubular member and having a valve seat therein and a movable valve adapted to engage said seat, said valve being adapted to be unseated by suction applied through the drill stem, a sealing disc closing the lower end of said housing, means supporting one or more loaded projectiles mounted in said housing and directed at said seal, firing pins operatively mounted in said projectile-supporting means, triggers mounted in firing proximity to said firing pins, and a trigger release member connected to said valve for holding said triggers in cocked position until the tool is in position for receiving the test fluid.

8. In a testing or sampling tool for oil wells and the like, a drill stem, a tubular member connected to said stem, a housing in communication with said tubular member and having a valve seat therein and a movable valve adapted to engage said seat, said valve being displaceable through suction applied through said drill stem, a sealing disc fixed in the lower portion of said housing, means supporting one or more loaded projectiles mounted in said housing and directed at said disc, firing pins operatively mounted in said projectile-supporting means, spring-pressed triggers mounted in firing proximity to said pins, and a trigger-engaging member connected to said valve for holding said triggers in cocked position until the tool is in position to receive the test fluid, said trigger release member being released upon unseating of said valve.

9. In a testing or sampling tool for oil wells and the like, a drill stem, a tubular member connected to said stem and providing a conduit in communication with the stem, a valve housing connected to the lower end of said tubular member and having a valve seat therein and a suction-release piston valve adapted to engage said seat, a sealing disc for closing the lower end of said housing until the tool is in position to receive the fluid to be tested, a ring mounted above said disc and formed with a plurality of bores directed toward said disc and each having a projectile barrel removably mounted therein, firing pins movably mounted in said ring above said barrels, triggers mounted in firing proximity to said pins, a trigger release member connected to said valve for holding said triggers in cocked position, said member being released from said triggers upon displacement of said valve from its seat.

10. In a testing or sampling tool for oil wells and the like, a hollow pipe member providing a housing, a sealing disc closing one end of said housing, a movable valve mounted in said housing, a projectile-supporting member located in said housing between said valve and disc, a removable barrel having a projectile therein mounted in said supporting member to point toward said disc, said barrel being removable for loading purposes, and means for firing said projectiles.

11. In a testing or sampling tool for oil wells and the like, a drill stem, a tubular member connected to said stem, a housing in communication with said tubular member and having a valve seat therein and a movable valve adapted to engage said seat, said valve being displaceable by suction, a sealing disc connected to said housing for closing off passage of fluid thereinto until the tool is in position to receve the fluid, a ring mounted in said housing above said disc and having a plurality of projectiles mounted therein to point toward said disc, firing pins mounted in said ring above said projectiles, spring-pressed triggers mounted in firing proximity to said pins, a trigger release member depending from said valve and adapted to engage and hold the triggers in position until the valve is unseated, and an inlet nipple connected to the lower end of said housing and removably locking the disc between the housing and nipple.

12. In a testing or sampling tool for oil wells and the like, a drill stem, a tubular housing connected to said stem for relative rotation, said housing having a sealing disc closing one end thereof, axially movable means operable to close communication between said housing and drill stem at the other end of said housing, and a projectile firing mechanism mounted within said housing between said axially movable means and disc and operable by a movement of said axially movable means to discharge and direct a projectile at said disc for puncturing the same.

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